HIGH-END COMPUTING CAPABILITY PORTFOLIO

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Ocean Simulation Animations Improved to Increase Detail

- The Visualization team updated the visualization database of results from the global 1/48th degree ECCO project's MITgcm ocean simulation with animations that show significantly more features.
  - The original visualizations had a color scale for each scalar that was the same for all ocean depths and across the globe. While the shared color scales simplified the comparison of different animations, they caused some animations to have limited detail.
  - Each of the 720,235 updated visualizations now has a custom color scale that was computed from a histogram of the underlying data.
  - The update was prompted by feedback from an ECCO project PI.
  - The new database is available at https://data.nas.nasa.gov/viz/vizdata/llc4320.
- The significant increase in detail required a 680% increase in total file size.
- The previous less-detailed visualizations have been popular, as indicated by the total of 734 gigabytes of animations downloaded to 357 unique IP addresses in 2021.

IMPACT: The new, more detailed visualizations will help ocean researchers to more fully understand the ocean simulation results.
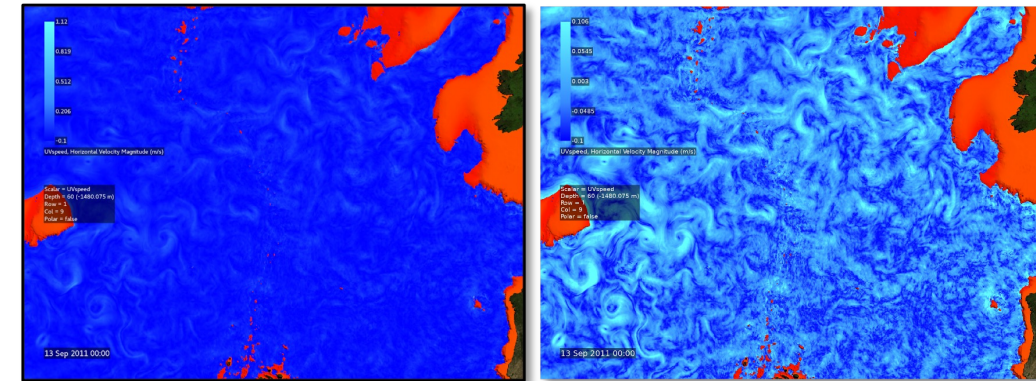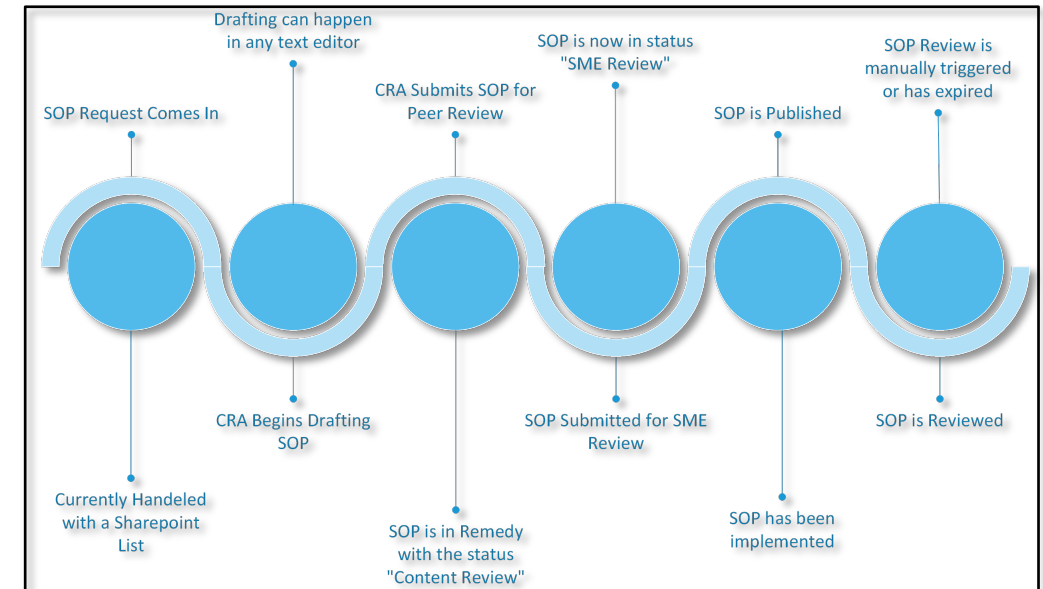

A comparison showing images from the old and new visualization database, with the earlier image on the left, and the corresponding new image on the right. The new image (and related animation) has many more features. Both images show horizontal velocity magnitude (speed) at 1480 m depth in the North Atlantic. *David Ellsworth, NASA/Ames*

New Control Room SOP Workflow to Improve User Support

- The HECC User Services and Tools Groups collaborated to develop workflows and processes around the creation, review, and lifecycle management for standard operating procedure (SOP) documents.
  - Existing features in Remedy were leveraged to provide a familiar interface and workflow for creating, managing, and accessing the SOP user interface.
  - SOP drafts are submitted using Microsoft Forms, with an automated pipeline to the next level as they are reviewed and approved.
- Control Room SOPs and all the associated processes around the lifecycle of the SOPs have empowered Control Room Analysts (CRAs) to provide the best quality support to our users.
  - The CRAs have begun taking ownership of documentation while working with subject matter experts to ensure the procedures are correct and validated.
  - CRAs are developing documentation, managing the review process, and working with subject matter experts from other teams to ensure the Control Room documentation is up to date and accurate.

IMPACT: Creating structure and validated, repeatable processes allows for the NAS Control Room to operate efficiently, accurately, and advance analysts to new skill levels to support users.


SOP Request Comes In

Drafting can happen in any text editor

CRA Submits SOP for Peer Review

SOP is now in status "SME Review"

SOP is Published

SOP Review is manually triggered or has expired

Currently Handeled with a Sharepoint List

CRA Begins Drafting SOP

SOP is in Remedy with the status "Content Review"

SOP Submitted for SME Review

SOP has been implemented

SOP is Reviewed

The standard operating procedure (SOP) workflow. *Rishabh Bajpai, NASA/Ames*

HECC Supercomputer Usage Hits New Normalized Record

- In June 2022, the combined usage of HECC supercomputers set a new normalized record of 13,655,190 Standard Billing Units (SBUs*).

- The usage by 384 of NASA's science and engineering groups exceeded the previous record of 13,151,227 SBUs, set in February 2022, by 503,966 SBUs.

- The record was achieved in great part by the Science Mission Directorate's Earth Science group from a coupled Goddard Earth Observing System (GEOS)/Estimating the Circulation and Climate of the Ocean (ECCO).

- Usage of Aitken, Pleaides, Electra, and Endeavour contributed to this record. The new record was enabled by the Aitken Rome nodes, with 128 cores per node.

- The top 10 projects' usage ranged between 261,092 and 1,671,207 SBUs, and together accounted for over 37% of the total usage.

- The HECC Project continues to evaluate and plan resources to address the future requirements of NASA's users.

1 SBU represents the work that can be done in 1 hour on a Pleiades Broadwell 28-core node.

IMPACT: Increasing the capacity of HECC systems and working with users to optimize runs within their allocations provides mission directorates with more resources to accomplish their goals and objectives.


GEOS/ECCO sea-surface speed   2020-05-28 21:00
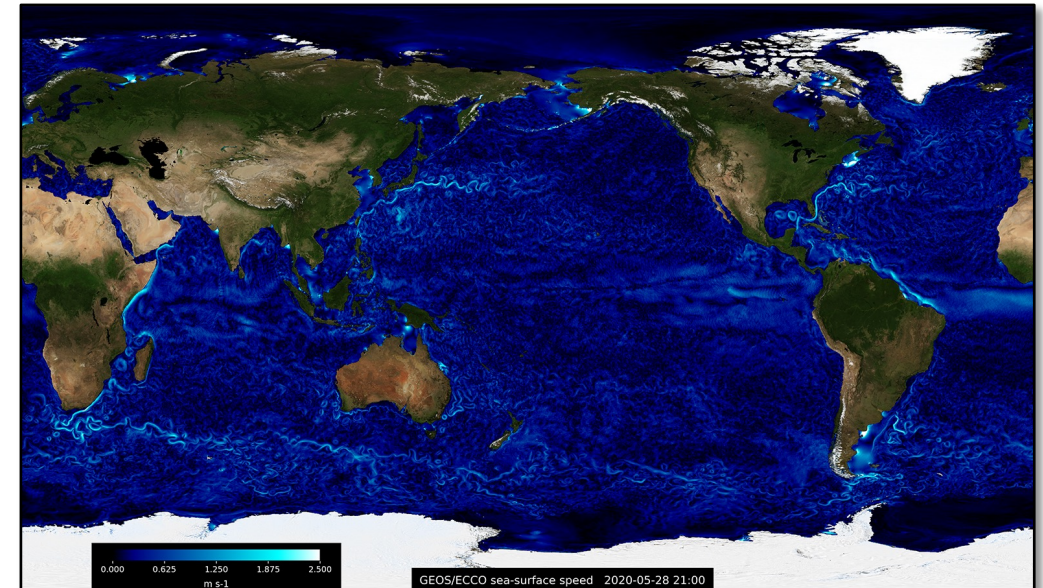
Sea-surface speed, in a snapshot from a GEOS/ECCO coupled ocean-atmosphere simulation with kilometer-scale resolution. Speed increases from black (0 meters per second, or m/s) to blue (~0.5 m/s) to white (>2.5 m/s). The image shows many concurrent processes including large scale and mesoscale eddies, tides, and the surface signature of internal waves. *Nina McCurdy, David Ellsworth, NASA/Ames*

Successful Migration to macOS Management II

- HECC's Engineering Server and Services (ESS) Group migrated the NAS Division's fleet of over 200 MacBooks from local configuration management to the agency-managed Jamf solution under macOS Management II (MOSM II)..
  - The NASA End User Services Office develops the operating systems security baselines, reducing the time needed for in-house development and rollout of new operating systems: from 15 months for version 10.13 down to 6 months for version 11.
  - Several core apps are also maintained and tested by MOSM II, further reducing upkeep: Microsoft Office, Chrome, Firefox, Cisco VPN.

- HECC can rely on MOSM II support and experts to resolve issues.
  - For example, the MOSM II team led the effort to reduce damage from an Apple bug ("hanging" software updates) by providing mitigation steps and coordinating an Apple support case on behalf of NASA.
  - Because HECC utilizes MOSM's remotely accessible Jamf cloud architecture, a discrepancy with agency-mandated "posture checks" during COVID in Spring 2022 was fixed without forcing users to come onsite.

- Local Macs were migrated two months before MOSM enrollment became mandatory. This hybrid-management partnership will continue yielding benefits as macOS 12 is introduced this year.

IMPACT: Migration to MOSM II support will shorten operating system preparation and deployment time, more efficiently resolve Mac system issues, and better address access-limitations imposed by widespread telework.
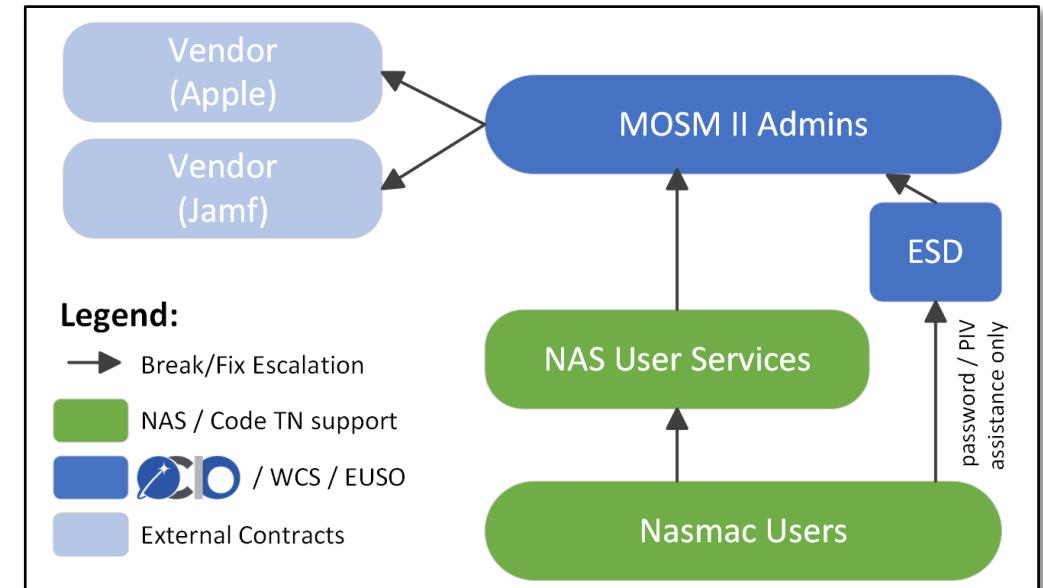
Support escalation paths, with an emphasis on the "hybrid support" nature of the MOSM II program. *Louis Wust, NASA Ames*

Simulating the Evolution of Galaxies Across Cosmic Time*

- As part of the Figuring Out Gas & Galaxies in Enzo (FOGGIE) project, astrophysicists from the Space Telescope Science Institute and Johns Hopkins University ran cosmological hydrodynamic simulations on Pleiades to trace the co-evolution of galaxies and their gas over 13.7 billion years of cosmic time.

- Using the Enzo Adaptive Mesh Refinement (AMR) cosmological hydrodynamics code, the researchers simulated the stellar and gaseous halos of six Milky Way-like galaxies in order to interpret data from Hubble and make detailed theoretical predictions for NASA's upcoming James Webb and Nancy Grace Roman Space Telescope missions.

- With high resolution applied to both the stars and gas within galaxies, the researchers achieved unprecedented precision in their simulations—at least an order of magnitude improvement over previous generations.

- The teams developed a new model for calculating the expected temperature of a virialized galaxy halo, which has significant ramifications for data obtained by observatories. They also completed four production simulations that will enable the Roman Space Telescope project team, and the wider astronomical community, to understand how Roman observations will explore nearby galaxies with its very large fields of view and superb image quality.

* HECC provided supercomputing resources and services in support of this work.

IMPACT: This project provides detailed theoretical predictions for NASA's upcoming Nancy Grace Roman Space Telescope—including simulated galaxies and mock data specifically intended for Roman—and for the James Webb and Hubble Space Telescopes. The work addresses NASA's strategic goal to understand the universe.

View of the gas in and around an evolving galaxy over 13 billion years. *Molly S. Peeples, Space Telescope Science Institute/Johns Hopkins University; Chris Henze, Timothy Sandstrom, NASA/Ames*

Predicting Jet Noise for the Low Boom Flight Demonstrator*

- Researchers at NASA Ames are performing scale-resolving simulations with the Launch Ascent and Vehicle Aerodynamics (LAVA) solver to predict jet acoustics for NASA's Low Boom Flight Demonstrator (LBFD).
  - Used both hybrid Reynolds-Averaged Navier-Stokes/Large-Eddy Simulation (RANS/LES) and Wall-Resolving Large-Eddy Simulation (WMLES) methods on cases with increasing complexity, such as jet-surface interaction noise, multi-stream, and chevron nozzle designs.
  - Initially, the LAVA team developed best practices and assessed uncertainties, strengths, and drawbacks in each methodology.

- To better quantify uncertainties, they generated an extensive database comprising several simulations in static and in-flight vehicle conditions and compared them with experimental data.
  - They applied lessons learned to a complex configuration, including several jet noise reduction technologies.

- The improved WMLES capabilities within the LAVA solver enabled the team to successfully predict jet noise and jet-surface interaction noise. Performance improvements reduced overall simulation time by about 65x and runtime from weeks to hours.

* HECC provided supercomputing resources and services in support of this work.

IMPACT: Findings from these simulations resulted in new insights and additional experimental investigations of certain flow phenomena, performed in collaboration with researchers at NASA Glenn. Gaining confidence in the predictive capabilities of hybrid RANS/LES for jet noise is another step toward vehicle certification by analysis.
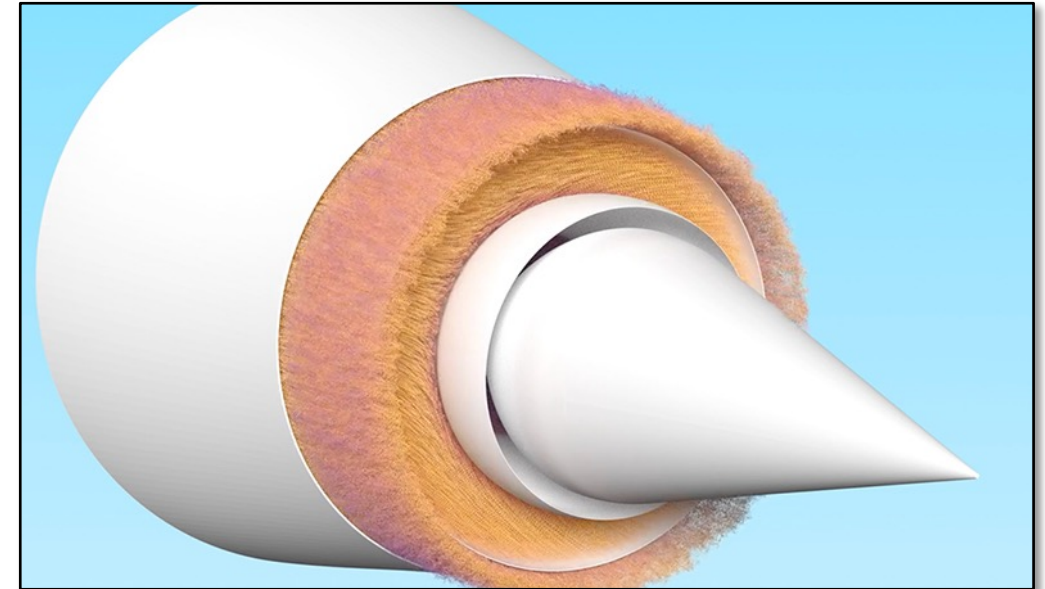
Video of wall-modeled large eddy simulation of a complex multi-stream nozzle, showing passive particles seeded at the inlet of each nozzle stream. Particles are colored by stream-wise velocity.
Timothy Sandstrom, Gerrit-Daniel Stich, NASA/Ames

Papers

- "**The Role of Magnetic Fields in the Stability and Fragmentation of Filamentary Molecular Clouds: Two Case Studies at OMC-3 and OMC-4**," P. S. Li, et al., Monthly Notices of the Royal Astronomical Society, vol. 514, issue 2, June 3, 2022. *
  https://academic.oup.com/mnras/article-abstract/514/2/3024/6601449

- "**Computation of Gust Induced Responses of an Air Taxi by using Navier-Stokes Equations**," G. Guruswamy, Aerospace Science and Technology, vol. 127, published online June 7, 2022.
  https://www.sciencedirect.com/science/article/abs/pii/S1270963822003583

- "**Reviving the Vortex Particle Method: A Stable Formulation for Meshless Large Eddy Simulation**," E. Alvarez, A. Ning, arXiv:2206.03658 [physics.flu-dyn], June 8, 2022. *
  https://arxiv.org/abs/2206.03658

- "**Shock Breakout in a 3-Dimensional Red Supergiant Envelopes**," J. Goldberg, Y.-F. Jiang, L. Bildsten, arXiv:2206.04134 [astro-ph.SR], June 8, 2022. *
  https://arxiv.org/abs/2206.04134

- "**TESS Hunt for Young and Maturing Exoplanets (THYME) VII: Membership, Rotation, and Lithium in the Young Cluster Group-X and a New Young Exoplanet**," E. Newton, et al., arXiv:2206.06254 [astro-ph.SR], June 13, 2022. *
  https://arxiv.org/abs/2206.06254

* HECC provided supercomputing resources and services in support of this work

Papers (cont.)

- **AIAA/CEAS Aeronautics 2022 Conference**, Southampton, UK, June 14–17, 2022.
    - "**Aeroacoustic Simulations of the High-Lift Common Research Model and Validation with Experiment**," D. Lockard, et al. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-2806
    - "**Lessons Learned on the Use of Data Surfaces for Ffowcs Williams-Hawkings Calculations: Airframe Noise Applications**,"
    A. Ribeiro, M. Khorrami, R. Ferris, B. Koening, P. Ravetta. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-2926
    - "**Fuselage Scattering Effects in a Hovering Quadcopter Drone**," A. Zarri, E. Dell'Erba, C. Schram. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-3031

- "**Transit Hunt for Young and Maturing Exoplanets (THYME) VIII: a Pleiades-age Association Harboring Two Transiting Planetary Systems from Kepler**," M. Barber, et al., arXiv:2206.08383 [astro-ph.EP], June 16, 2022. *
https://arxiv.org/abs/2206.08383

- "**The Stellar Metallicity Gradients of Local Group Dwarf Galaxies**," S. Taibi, G. Battaglia, R. Leaman, et al., arXiv:2206.08988 [astro-ph.GA], June 17, 2022. *
https://arxiv.org/abs/2206.08988

- "**Figuring Out Gas & Galaxies in Enzo (FOGGIE) VI: The Circumgalactic Medium of L* Galaxies is Supported in an Emergent, Non-Hydrostatic Equilibrium**," C. Lochhaas, et al., arXiv:2206.09925 [astro-ph.GA], June 20, 2022. *
https://arxiv.org/abs/2206.09925

Papers (cont.)

- "**Confinement of the Solar Tacholine by Dynamo Action in the Radiative Interior**," L. Matilsky, et al., arXiv:2206.12920 [astro-ph.SR], June 26, 2022. *
https://arxiv.org/abs/2206.12920

- **AIAA Aviation 2022 Forum**, Chicago, IL, June 27–July 1, 2022.

  - "**Nonlinear Evolution of Instabilities in a Laminar Separation Bubble at Hypersonic Mach Number**," F. Li, M. Choudhari, et al. *
  https://arc.aiaa.org/doi/abs/10.2514/6.2022-3855

  - "**Combined Bluntness and Roughness Effects on Cones at Hypersonic Speeds**," P. Paredes, A. Scholten, M. Choudhari, et al. *
  https://arc.aiaa.org/doi/abs/10.2514/6.2022-3340

  - "**Effect of the Reynolds Number on the Freestream Disturbance Environment in a Mach 6 Nozzle**," N. Hildebrand, et al. *
  https://arc.aiaa.org/doi/abs/10.2514/6.2022-3776

  - "**Stability Analysis of Streaks Induced by Optimized Vortex Generators**," C. Klauss, C. Pederson, et al. *
  https://arc.aiaa.org/doi/abs/10.2514/6.2022-3249

  - "**Implementation of an Unsteady PSP System in the NASA Transonic Dynamics Tunnel**," D. Reese, S. Peak, et al. *
  https://arc.aiaa.org/doi/abs/10.2514/6.2022-3784

  - "**Linear Disturbance Amplification Over Blunted Flat Plates in High-Speed Flows**," A. Scholten, H. Goparaju, et al. *
  https://arc.aiaa.org/doi/abs/10.2514/6.2022-3471

  - "**FUN3D Simulations for the 4th AIAA High-Lift Prediction Workshop**," N. Ahmad, L. Wang, et al. *
  https://arc.aiaa.org/doi/abs/10.2514/6.2022-3436

* HECC provided supercomputing resources and services in support of this work

Papers (cont.)

- **AIAA Aviation 2022 Forum (cont.)**
    - "**Numerical Investigation of Flow Over Periodic Hill**," J.-P. Mosele, A. Gross, J. Slater. *
      https://arc.aiaa.org/doi/abs/10.2514/6.2022-3228

    - "**Computational Fluid Dynamic Optimization of an Experimental Rotating Detonation Rocket Engine Nozzle**," D. Paxson, et al. *
      https://arc.aiaa.org/doi/abs/10.2514/6.2022-4107

    - "**Optimization of Parametric Lobe Mixer for Internally Mixed Nozzles**," W. Banks. *
      https://arc.aiaa.org/doi/abs/10.2514/6.2022-3261

- "**The TESS-Keck Survey. XIII. An Eccentric Hot Neptune with a Similar-Mass Companion around TOI-1272**,"
  M. MacDougall, et al., arXiv:2206.14327 [astro-ph.EP], June 28, 2022. *
  https://arxiv.org/abs/2206.14327

- "**APOGEE-Centric Ananke Simulations in a SciServer SQL Database**," R. Beaton, et al., Research Notes of the AAS,
  vol. 6, no. 6, published online June 2022. *
  https://iopscience.iop.org/article/10.3847/2515-5172/ac7808/meta

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Presentations

- **AIAA/CEAS Aeronautics 2022 Conference**, Southampton, UK, June 14–17, 2022.
  - "**Wall-Modeled Large-Eddy Simulation of Jet Noise in Flight Conditions**," G.-D. Stich, A. Ghate, J. Housman, C. Kiris. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-3002
  - "**Predictions of LAGOON Nose Landing Gear Flow and Noise using Wall-Modeled Large Eddy Simulations**," M. L. Wong, G. Kenway, A. Ghate, G.-D. Stich, C. Kiris. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-2850

- **AIAA Aviation 2022 Forum**, Chicago, IL, June 27 – July 1, 2022.
  - "**A Reynolds-Averaged Navier-Stokes Perspective for the High Lift-Common Research Model Using the LAVA Framework**," J. Duensing, J. Housman, L. Fernandez, L. Machado, C. Kiris. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-3742
  - "**Toward Verification of γ-Reθt Transition Model in OVERFLOW and FUN3D**," B. Shankar Venkatachari, Marie Denison, et al. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-3679
  - "**Goal-Oriented Discretization Error Control in Coupled Nearfield-Farfield Low-Boom Simulations**," M. Nemec, M. Aftosmis, S. Rallabhandi, D. Rodriguez. *
    https://arc.aiaa.org/doi/abs/10.2514/6.2022-4085
  - "**HLPW-4/GMGW-3: Wall-Modeled LES and Lattice-Boltzmann Technology Focus Group Workshop Summary**," C. Kiris, A. Ghate, O. Browne, J. Slotnick, J. Larsson.
  - "**A Wall-Modeled LES Perspective for the High Lift Common Research Model Using LAVA**," A. Ghate, G.-D. Stich, G. Kenway, J. Housman, C. Kiris.

Presentations (cont.)

- **AIAA Aviation 2022 Forum** (cont.)
    - "**A Hybrid RANS-LES Perspective for the High Lift Common Research Model Using LAVA**," O. Browne, J. Housman, G. Kenway, A. Ghate, C. Kiris.

    - "**Automation of Overset Structured Mesh Generation on Boundary Representation Geometries**," W. Chan, S. Pandya, A. Chuen.

    - "**A Reynolds-Averaged Navier-Stokes Perspective for the High Lift-Common Research Model Using the LAVA Framework**," J. Duensing, J. Housman, L. Fernandes, L. Machado, C. Kiris.

    - "**Application of the RANS-DNS Framework to Post-processing the Mixing Layer DNS Data**," M. Abuhegazy, O. Mahfoze, S. Murman, S. Poroseva.

News and Events: Social Media

- **Coverage of NAS Stories**
  - Stellar Magnetic Field research from UC Boulder/JILA:
    - NAS: [Twitter](#) 3 retweets, 7 likes.
  - Princeton Lunar Hydration simulations by NAS Visualization team:
    - NAS: [Twitter](#) 6 likes.
    - NASA Supercomputing: [Facebook](#) 2,237 users reached, 82 engagements, 42 likes, 6 share.
  - NAS LAVA Team Artemis research interview (throwback):
    - NAS: [Twitter](#) 5 retweets, 14 likes, 2 replies.
    - NASA Supercomputing: [Facebook](#) 1,628 users reached, 48 engagements, 26 likes, 1 share.
  - Rotorcraft visualization work:
    - NAS: [Twitter](#) 4 retweets, 9 likes, 1 reply.
    - NASA Supercomputing: [Facebook](#) 270 users reached, 30 engagements, 7 likes, 2 shares.

HECC Utilization

June 2022
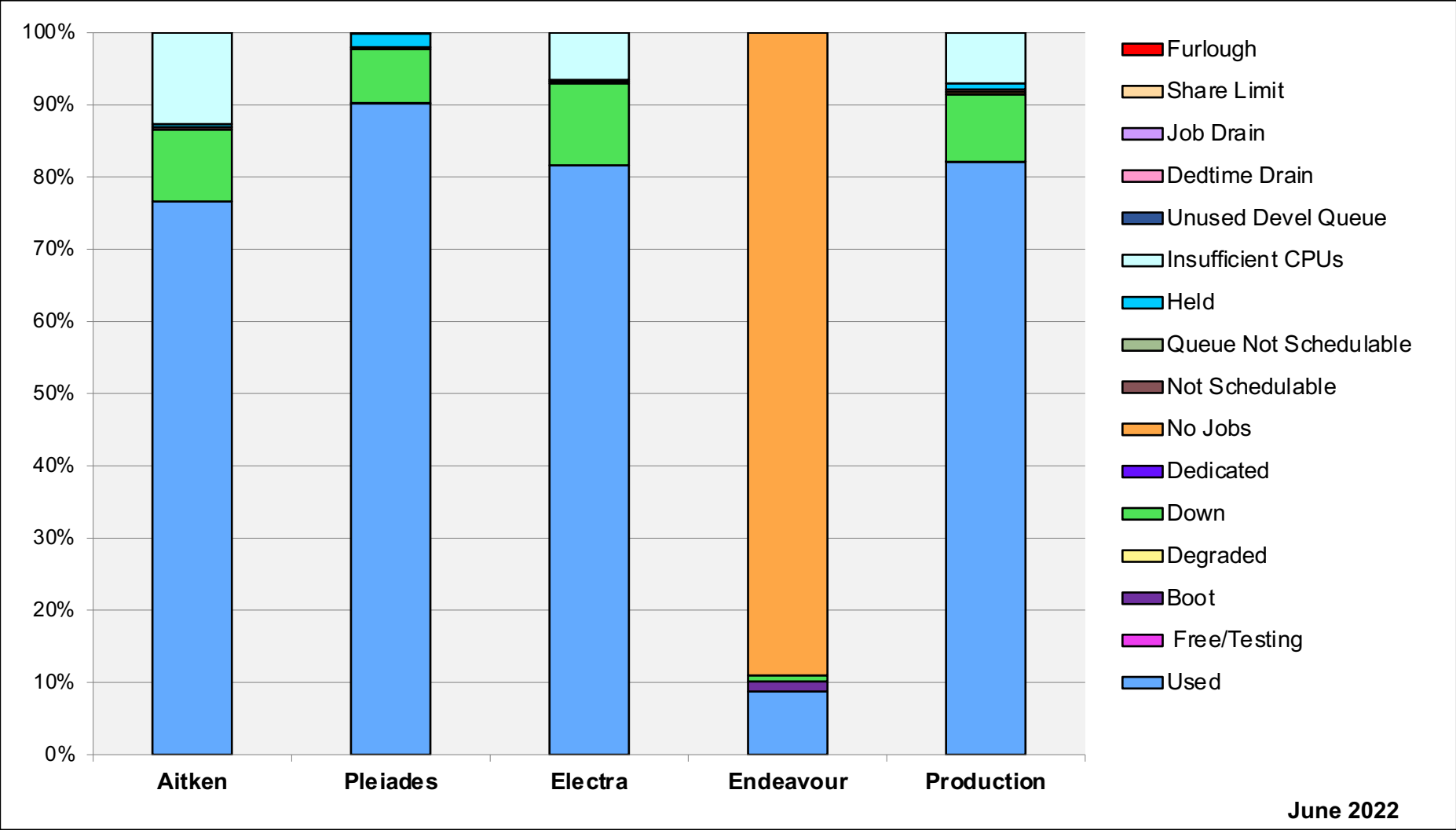
HECC Utilization Normalized to 30-Day Month

HECC Utilization Normalized to 30-Day Month

① 8 Rome Apollo racks introduced into Aitken

② Endeavour replaced with new hardware

③ Merope retired

④ 4 Rome Apollo Racks added to Aitken

⑤ 4 Rome Apollo Racks added to Aitken

Tape Archive Status

June 2022
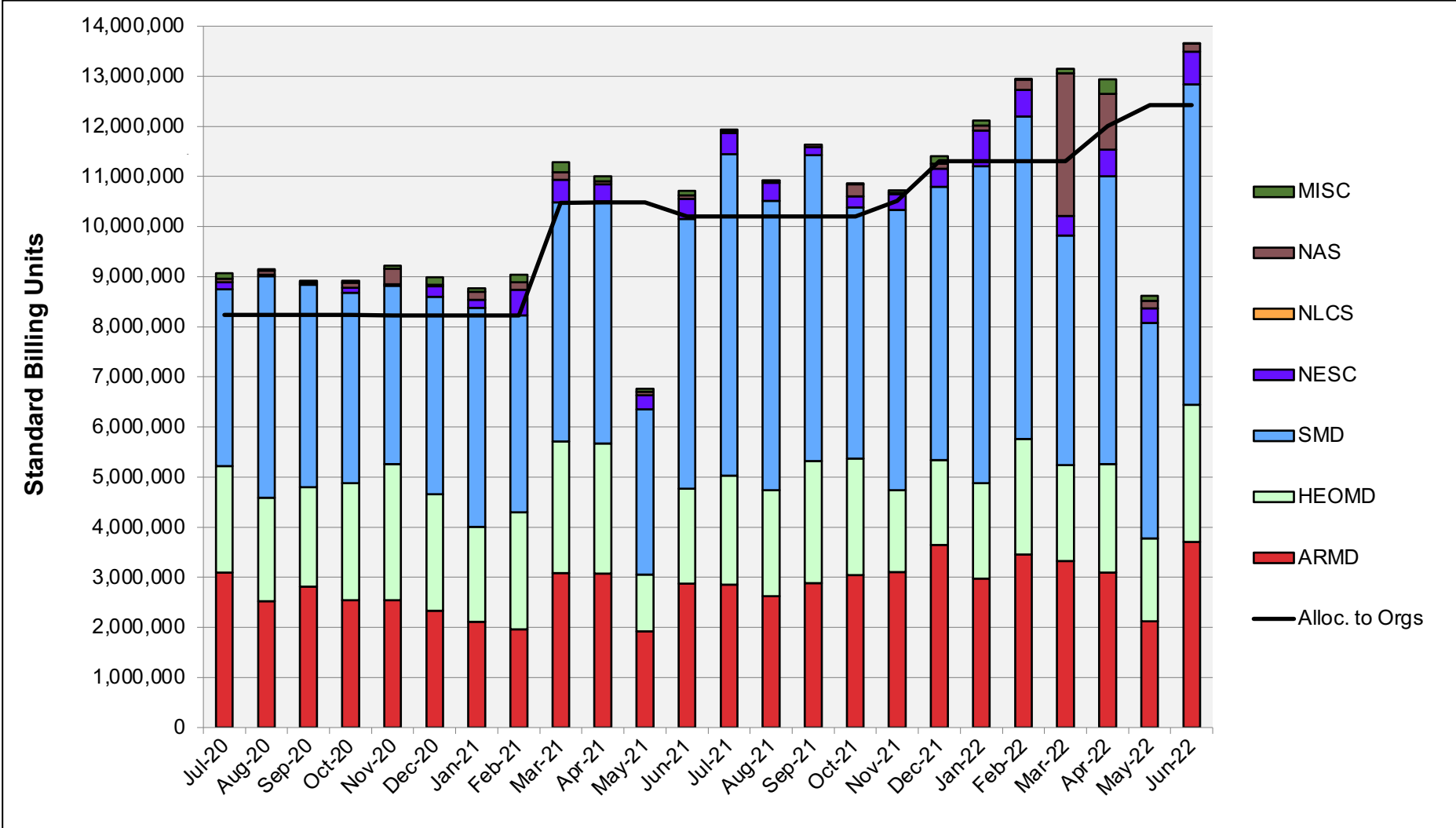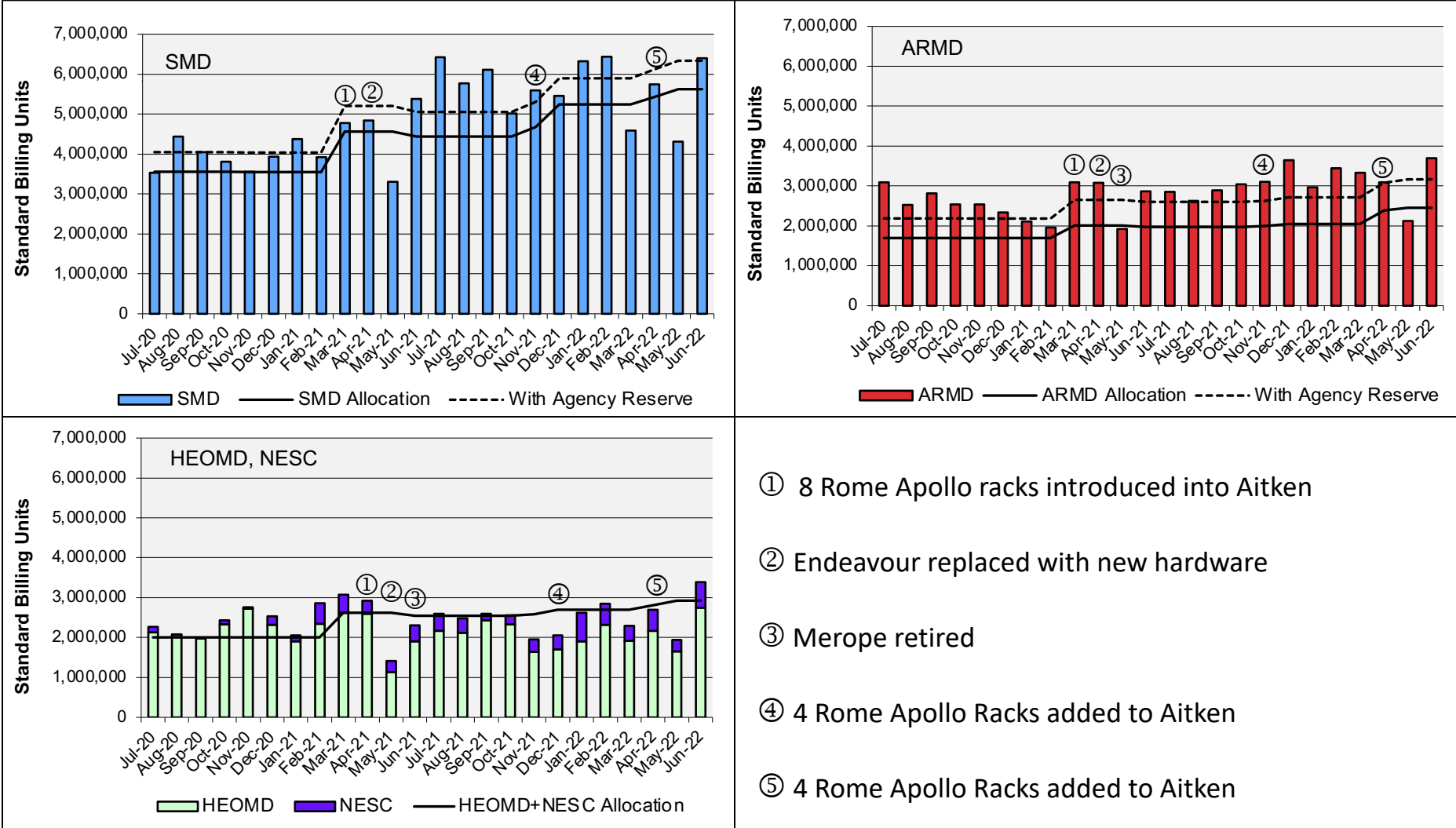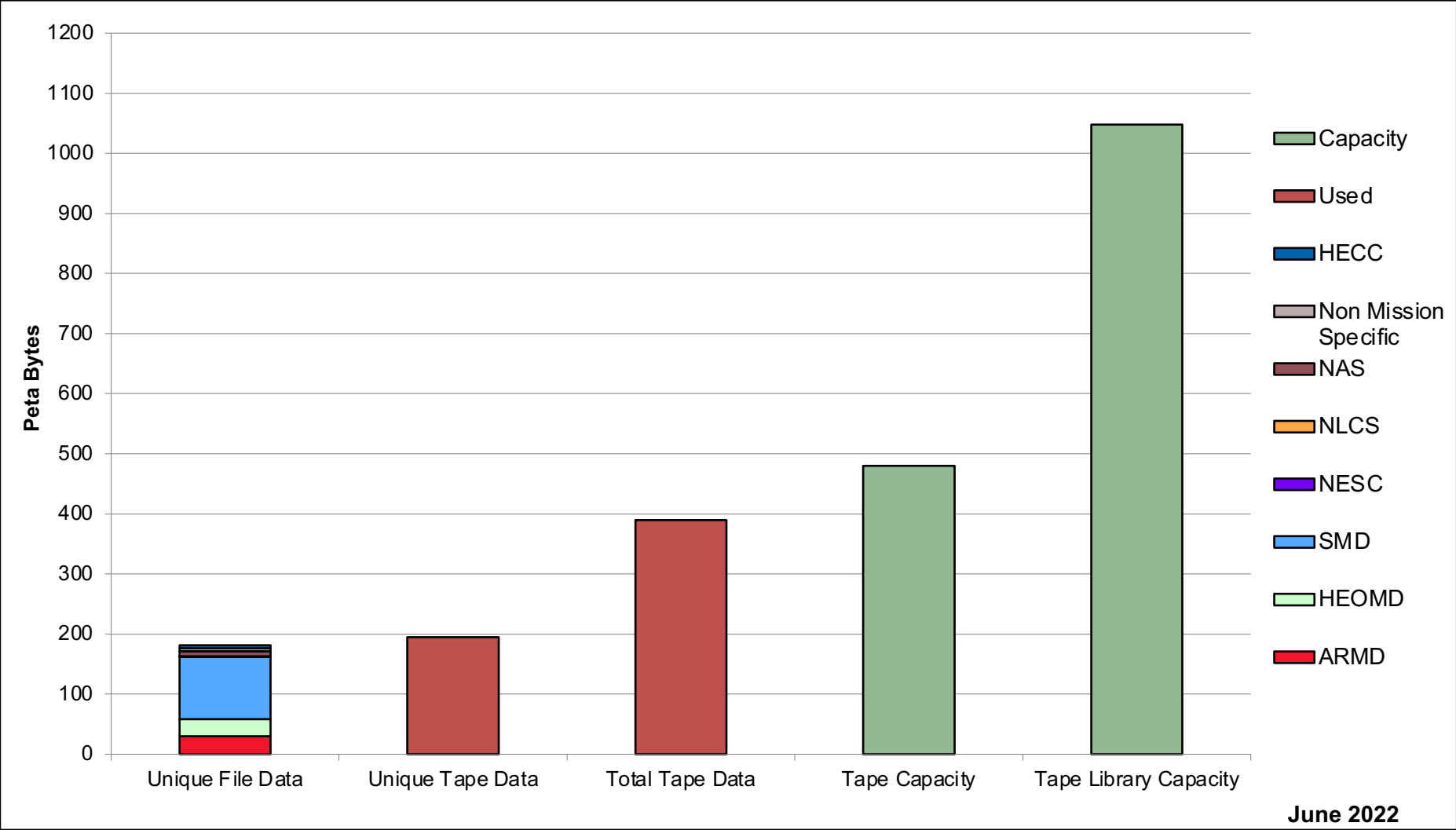
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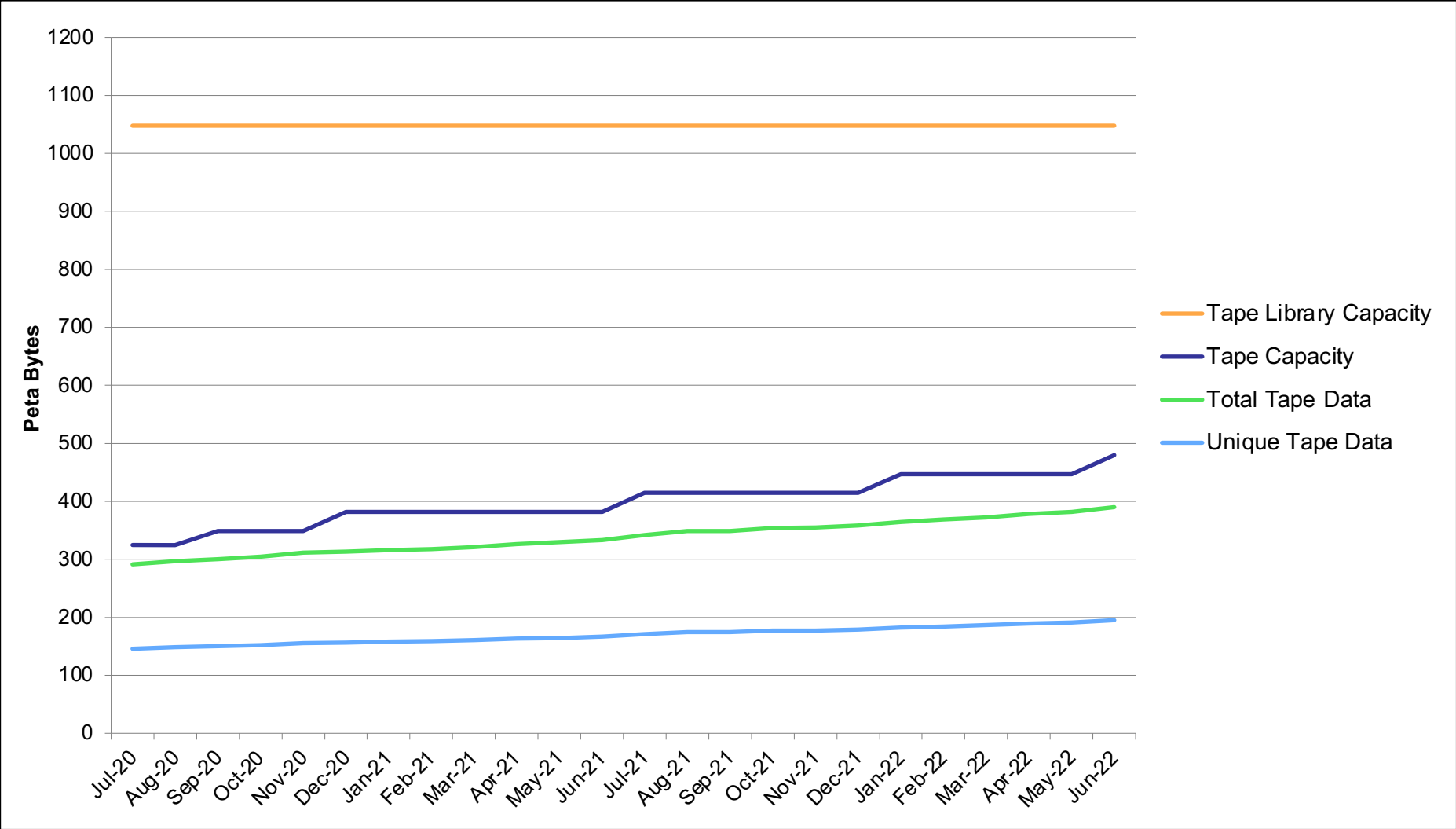
Aitken: SBUs Reported, Normalized to 30-Day Month
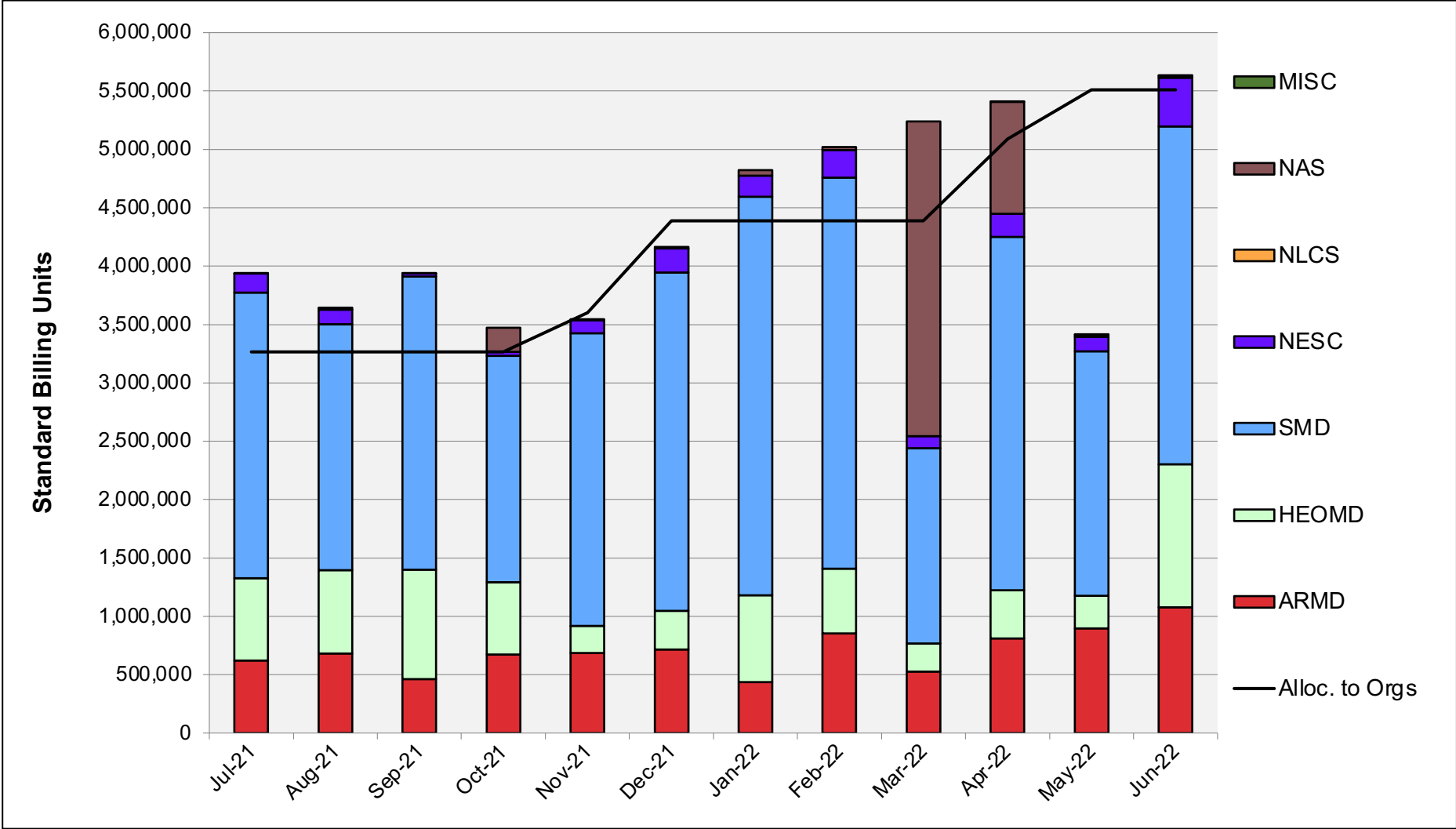
# Aitken: Devel Queue Utilization

Aitken: Monthly Utilization by Job Length

June 2022
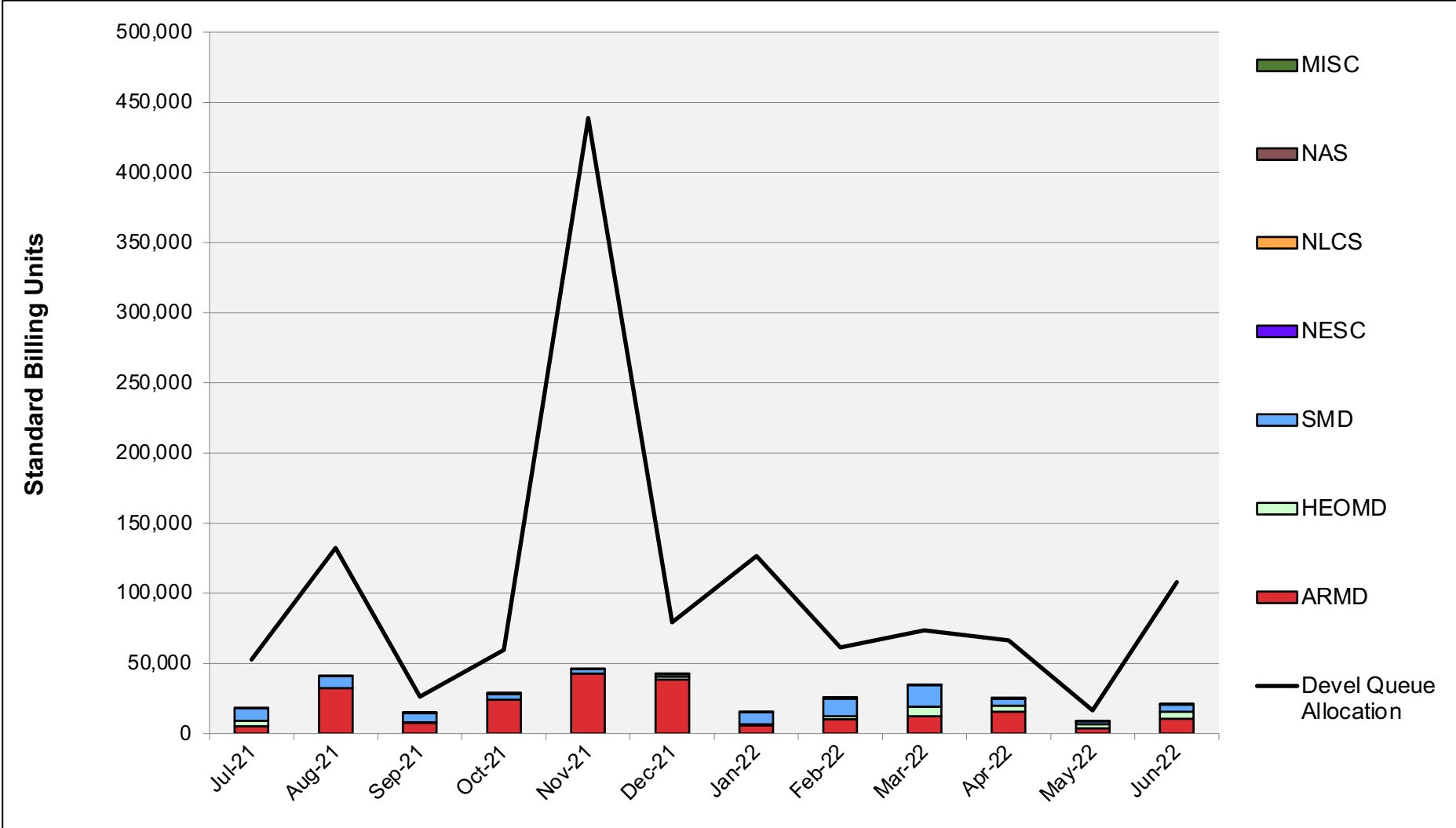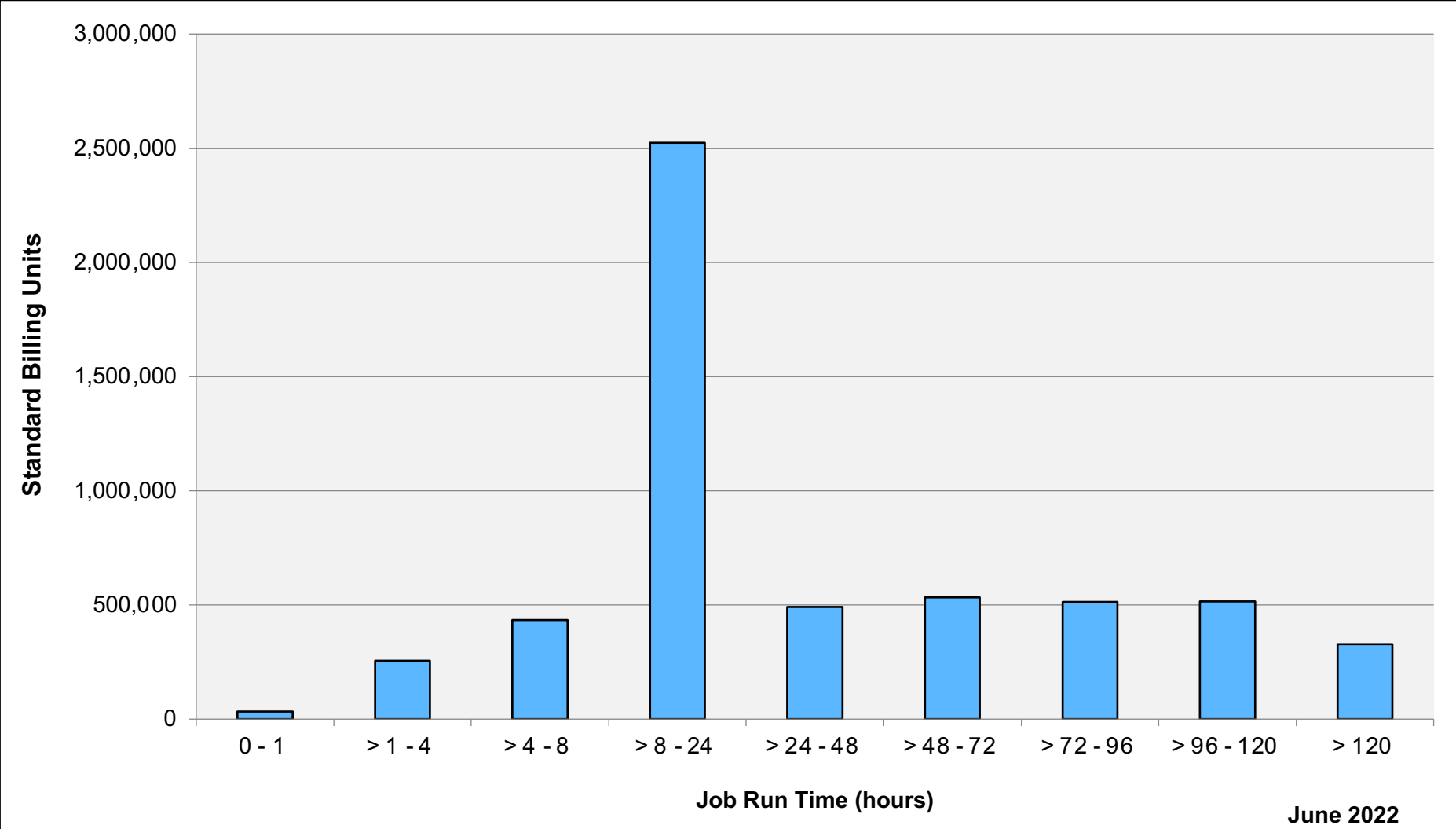
Aitken: Monthly Utilization by Job Size

Aitken: Monthly Utilization by Size and Length

June 2022
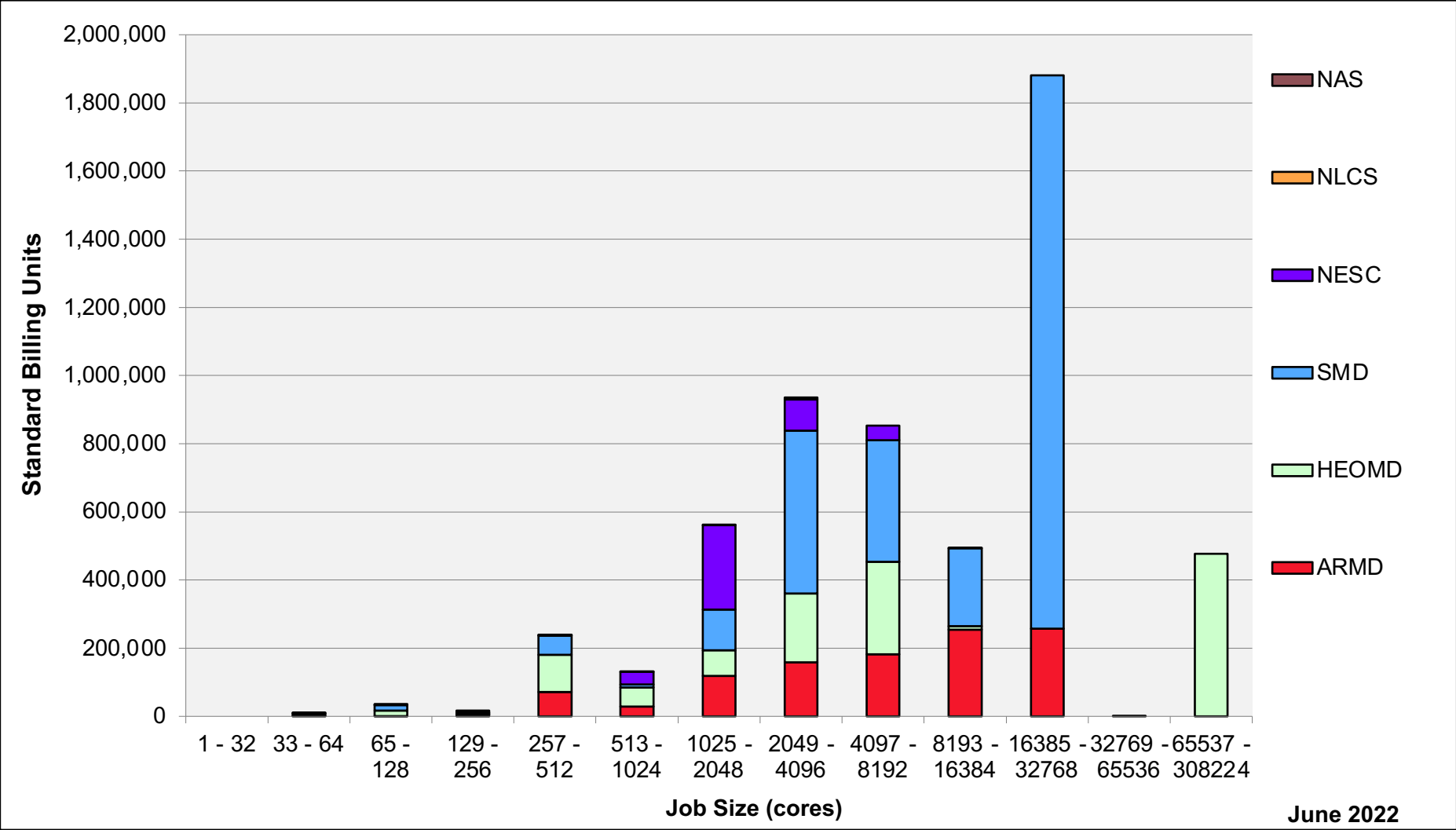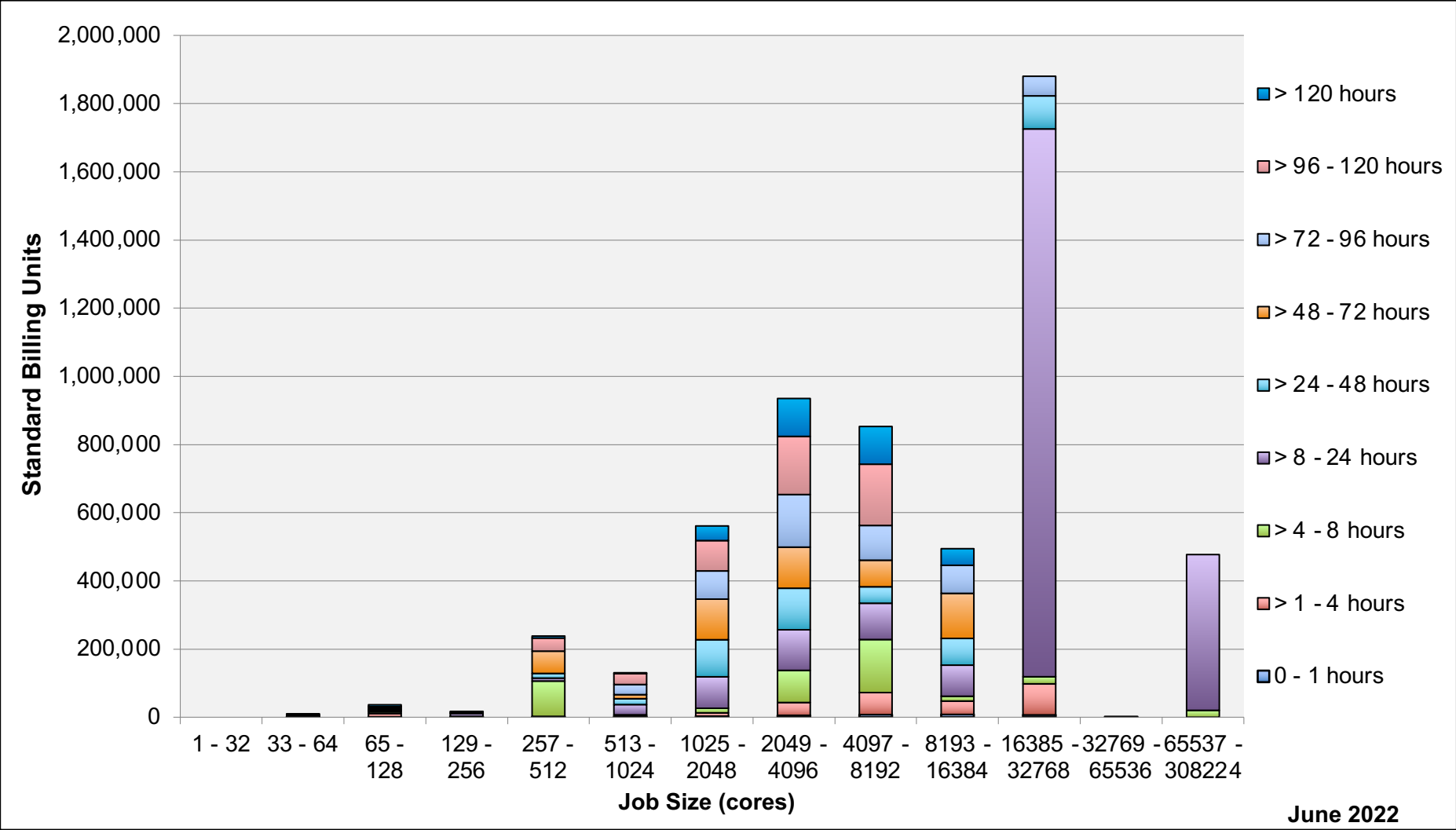
Aitken: Average Time to Clear All Jobs
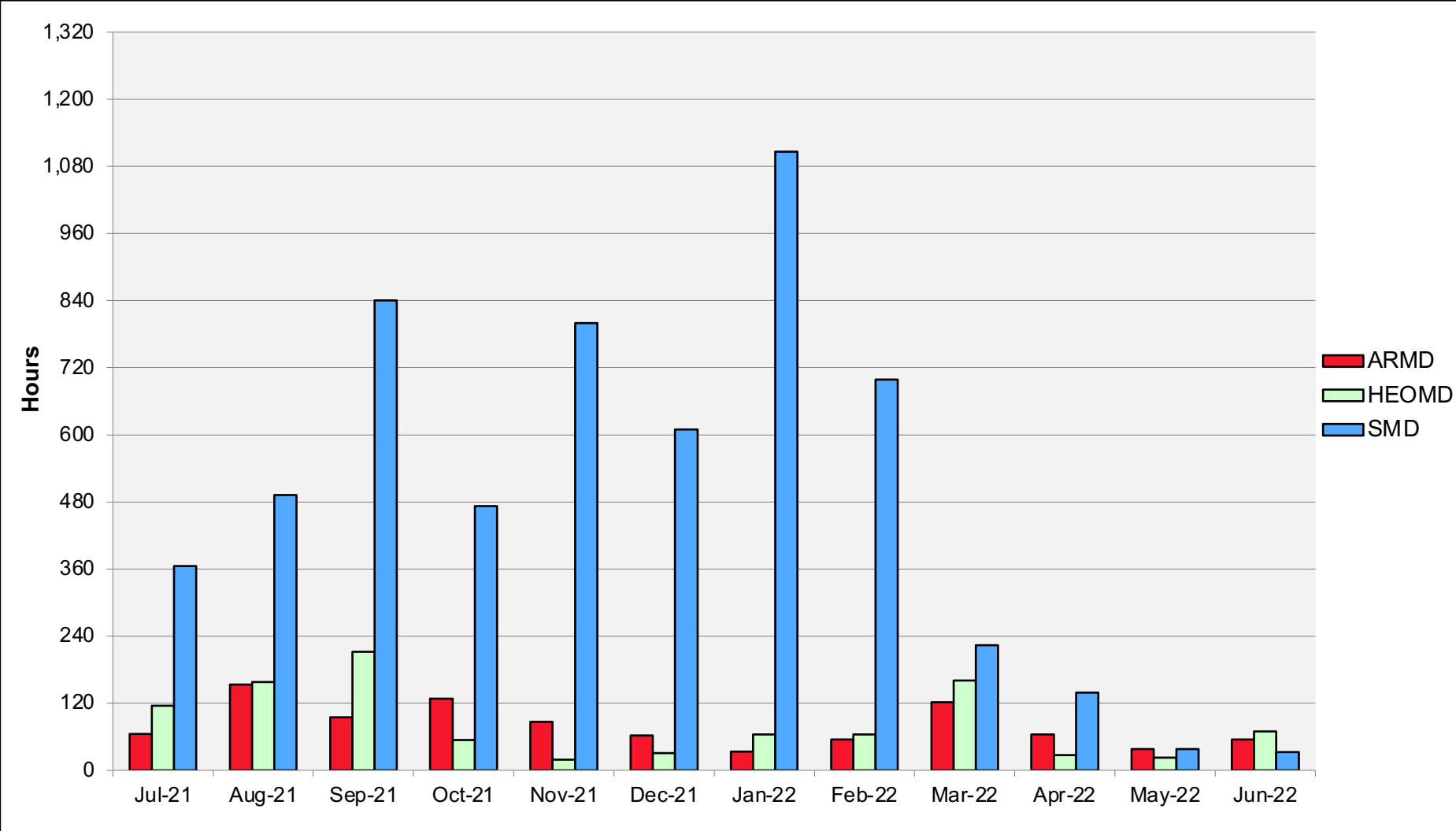
Aitken: Average Expansion Factor
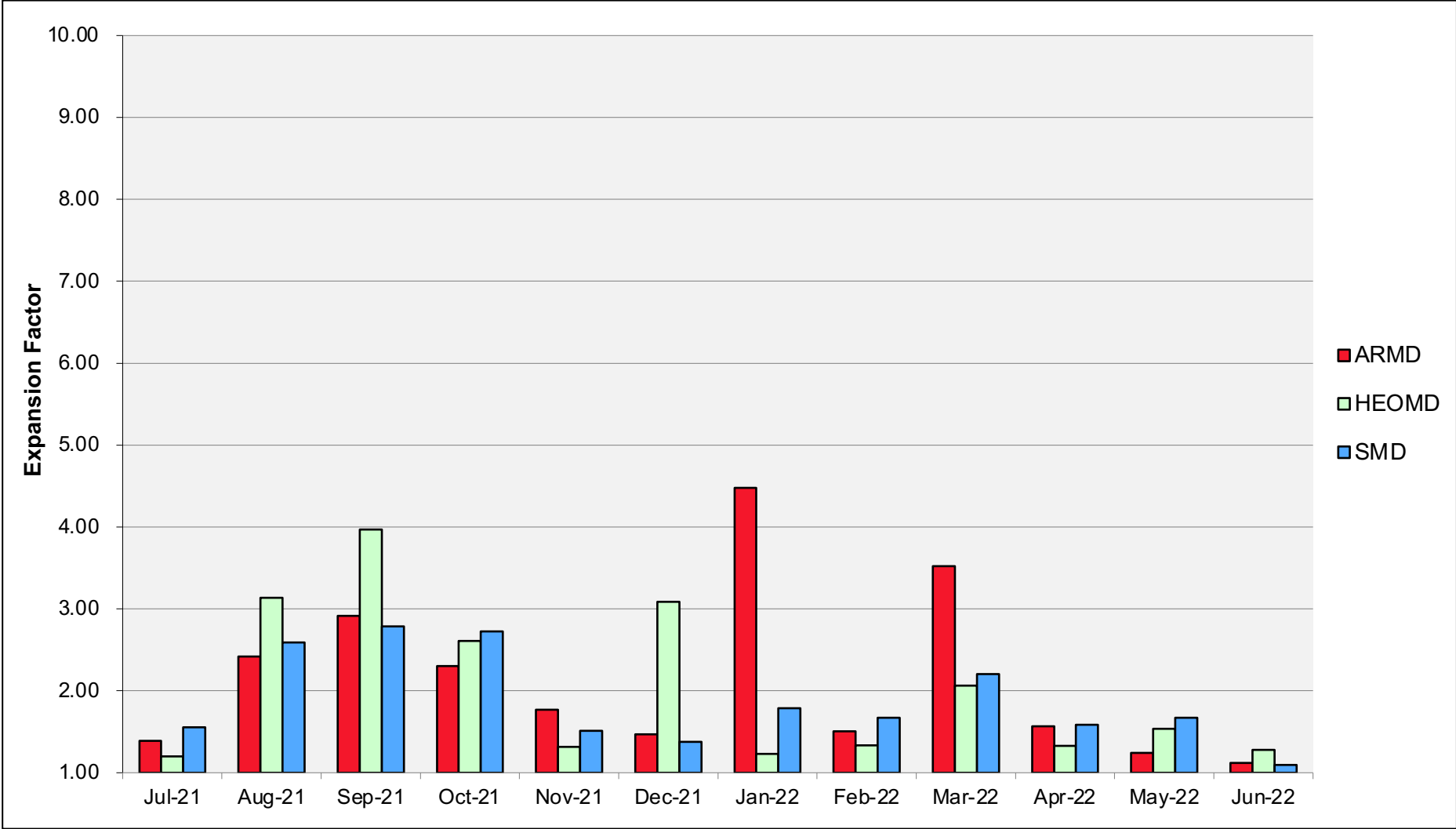
Pleiades: SBUs Reported, Normalized to 30-Day Month
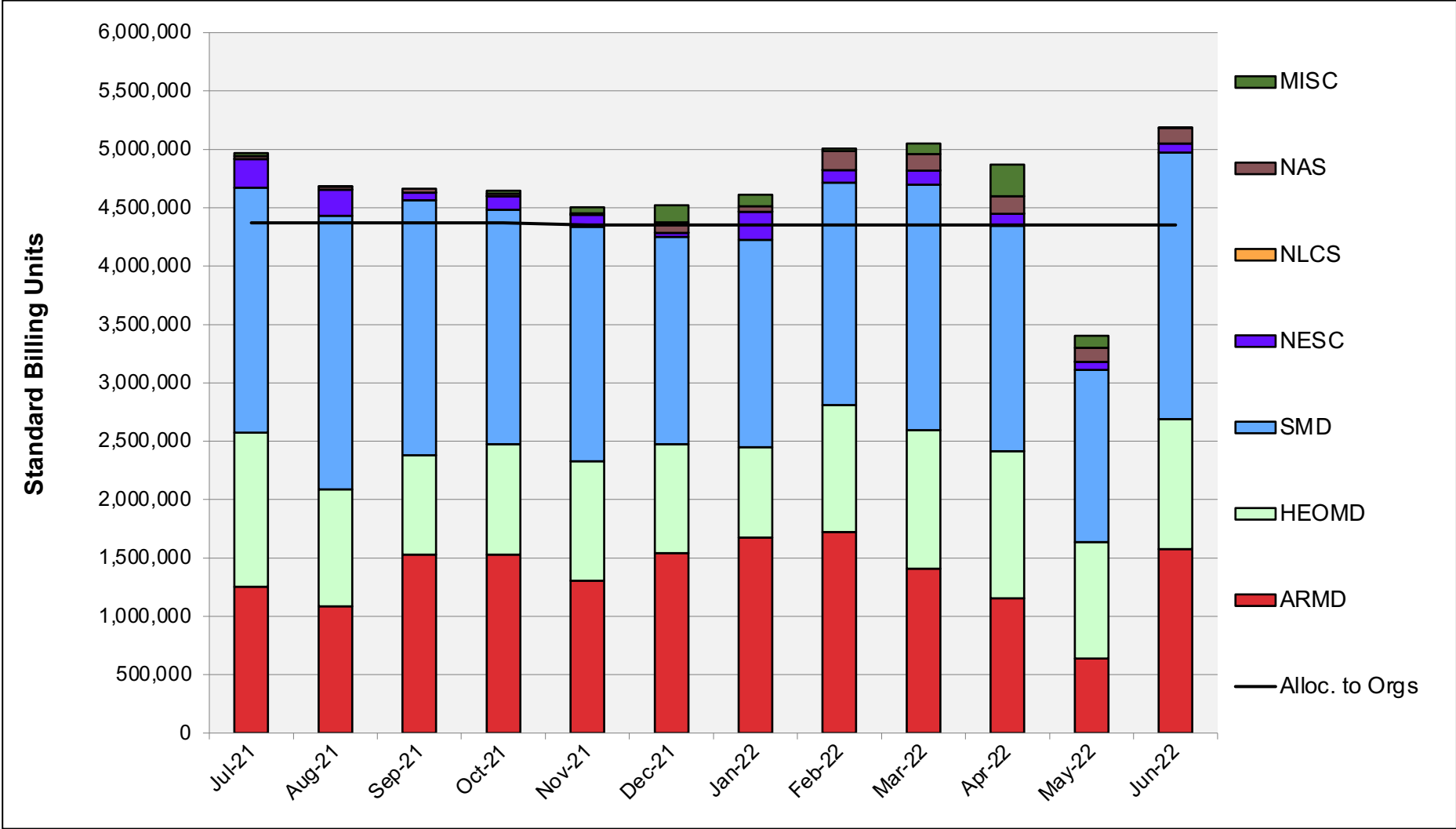
Pleiades: Devel Queue Utilization

Pleiades: Monthly Utilization by Job Length

June 2022
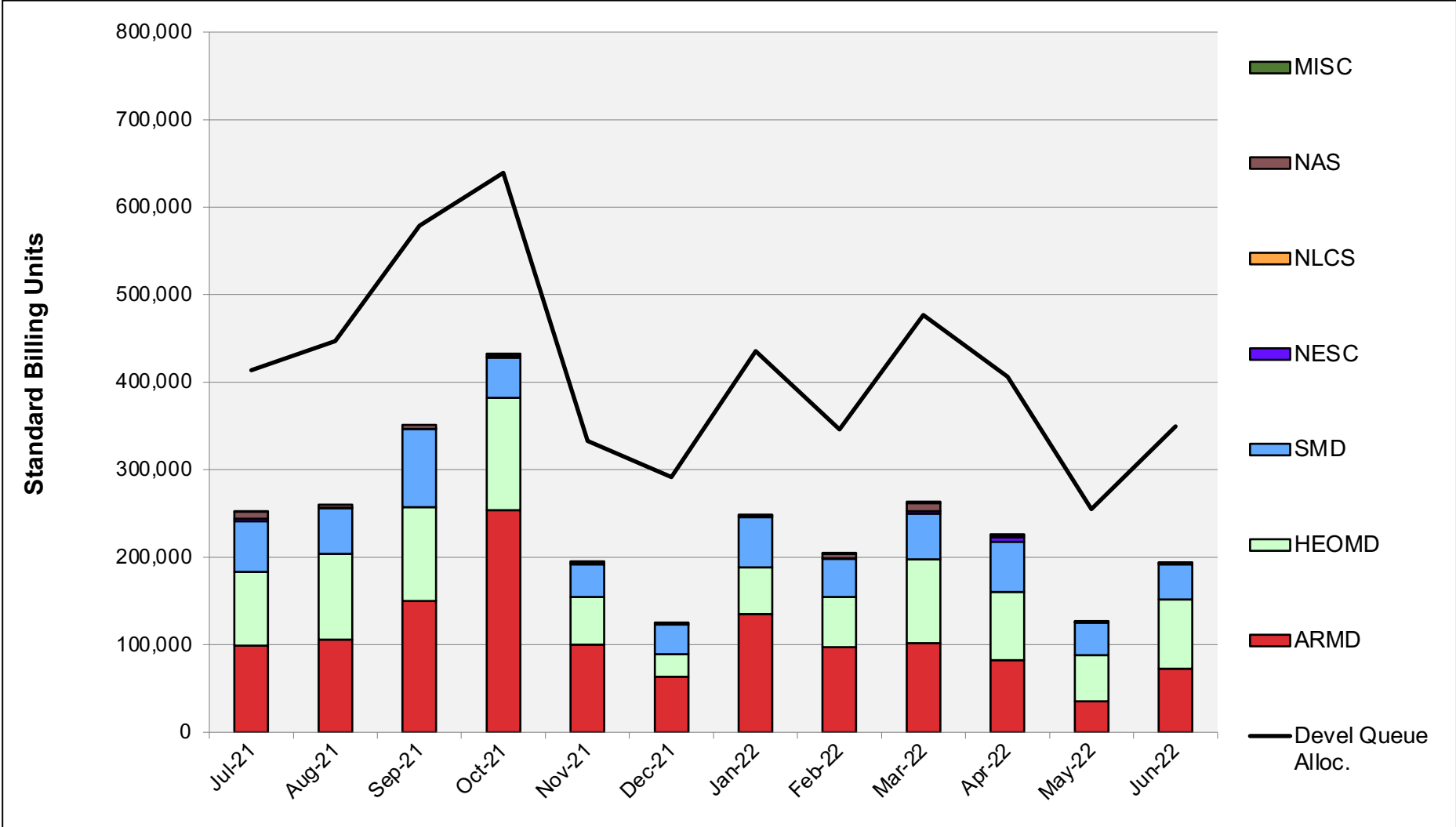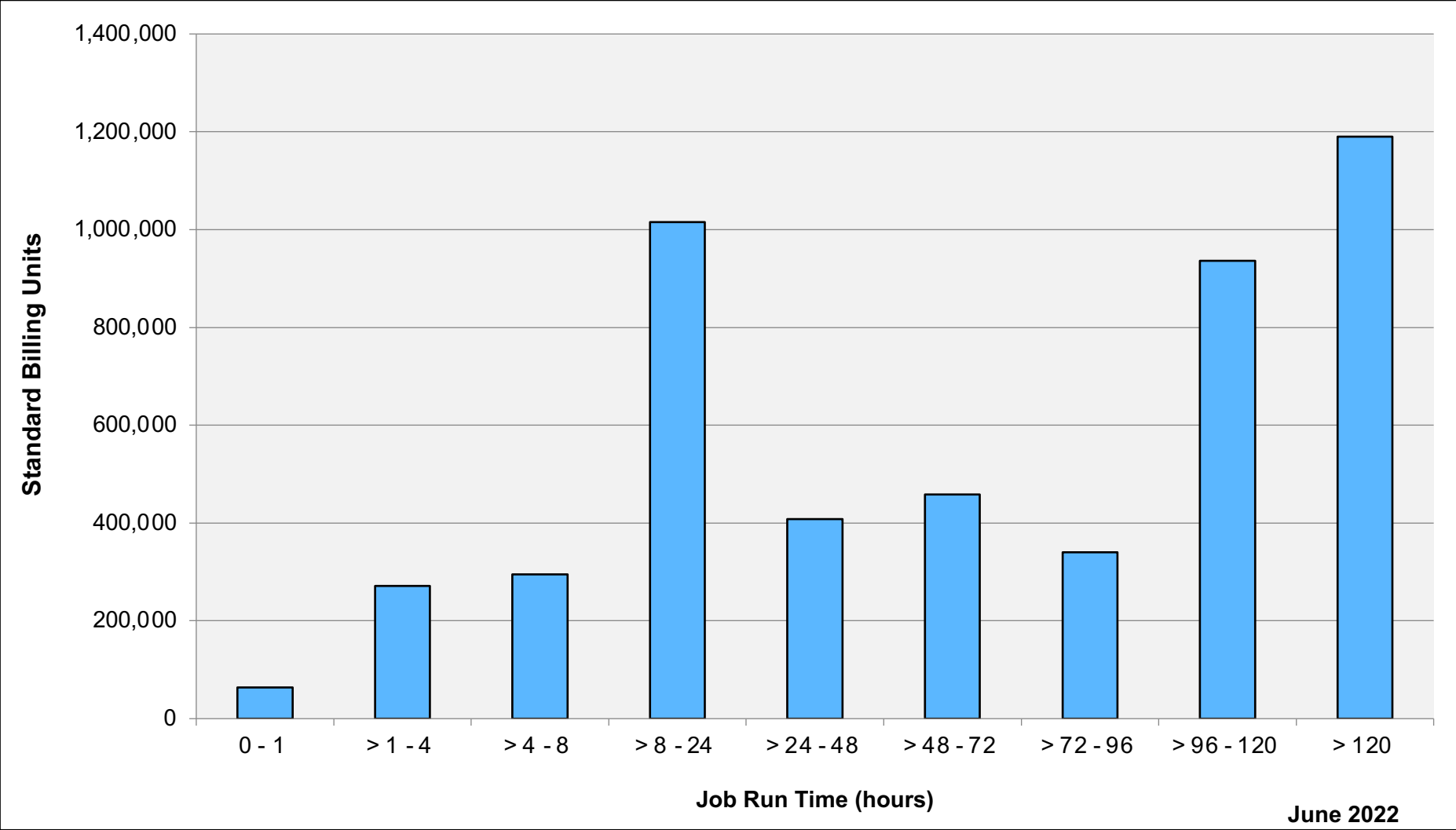
Pleiades: Monthly Utilization by Job Size

Pleiades: Monthly Utilization by Size and Length

June 2022
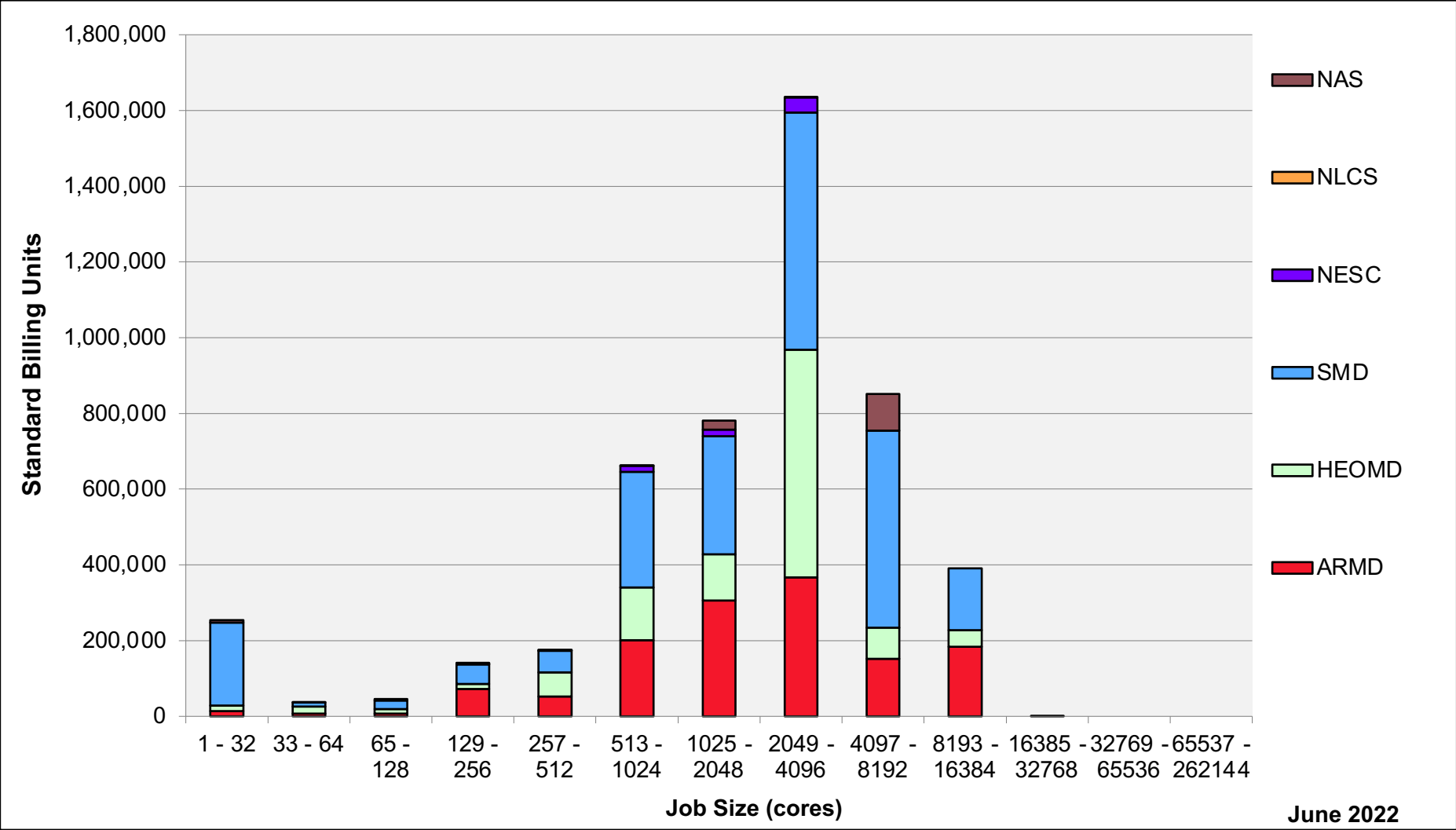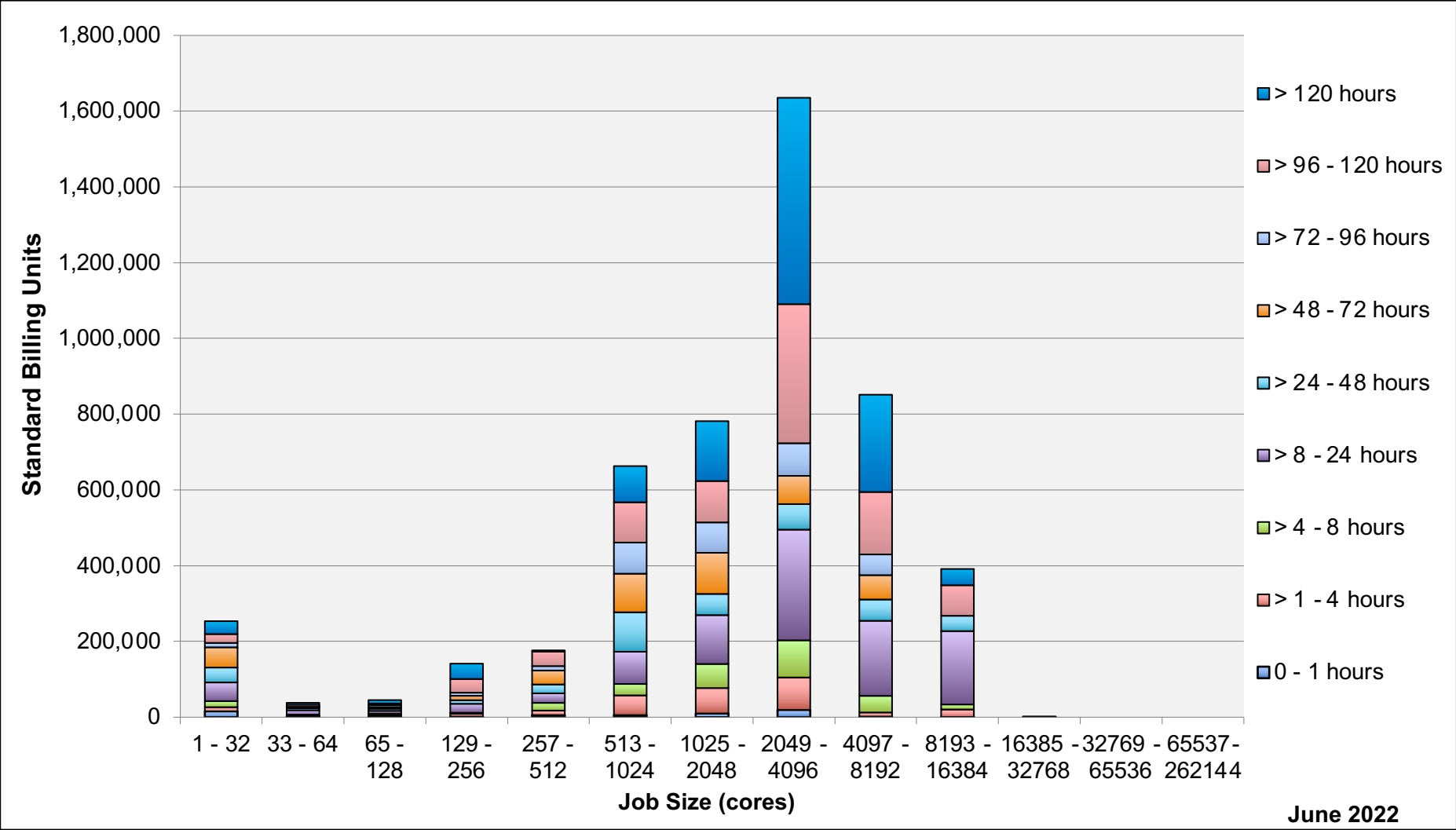
Pleiades: Average Time to Clear All Jobs
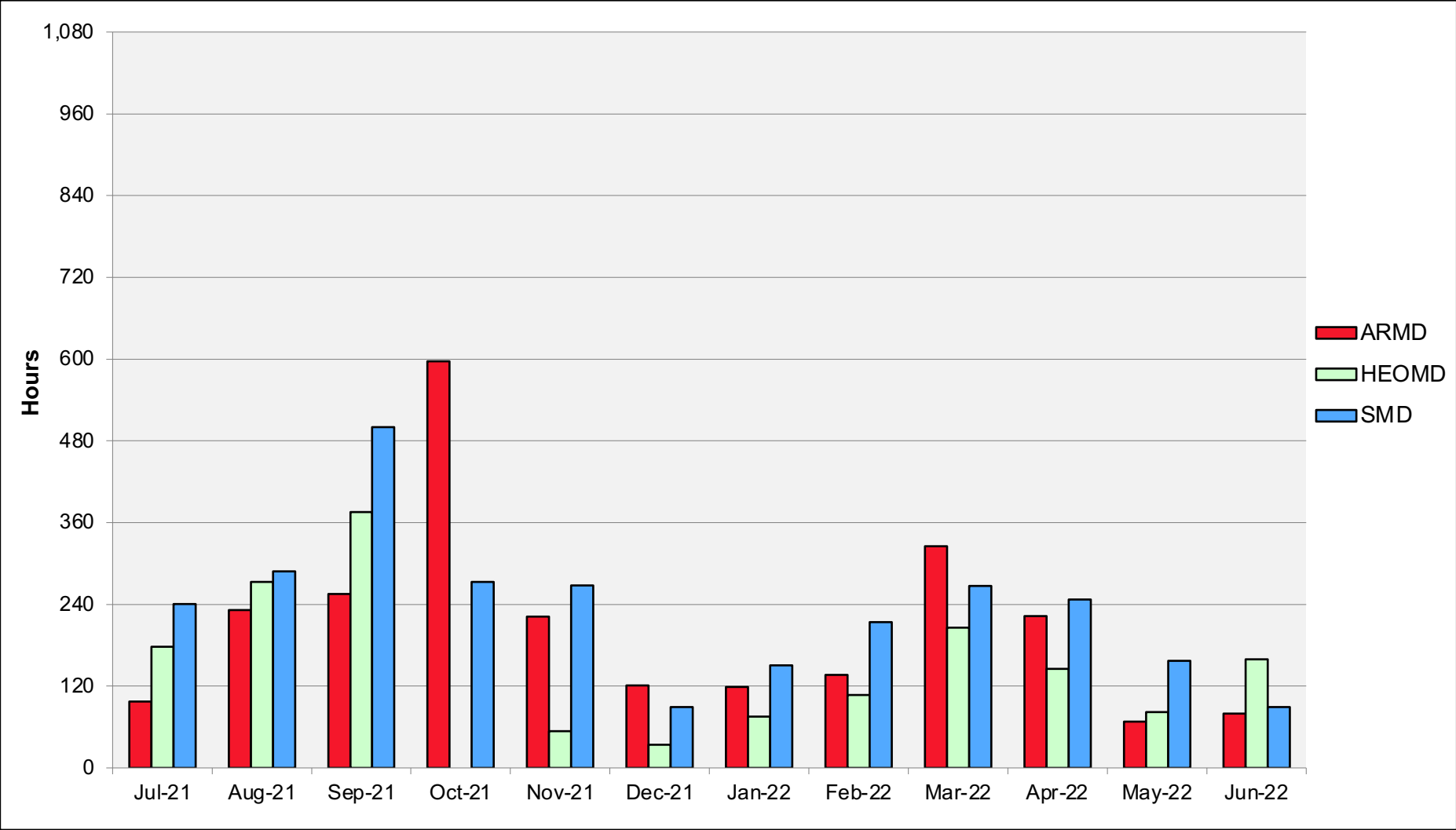
Pleiades: Average Expansion Factor
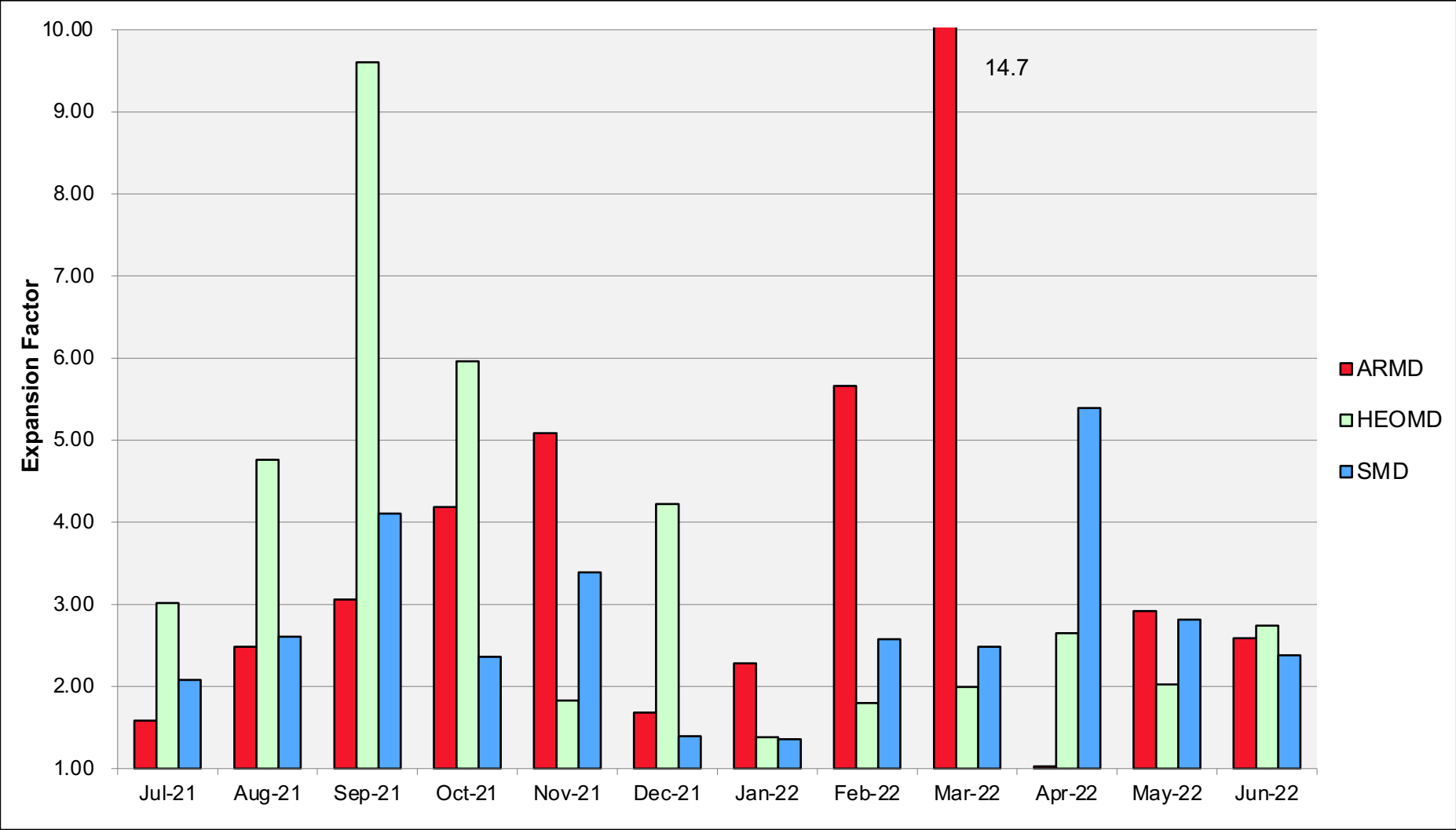
Electra: SBUs Reported, Normalized to 30-Day Month
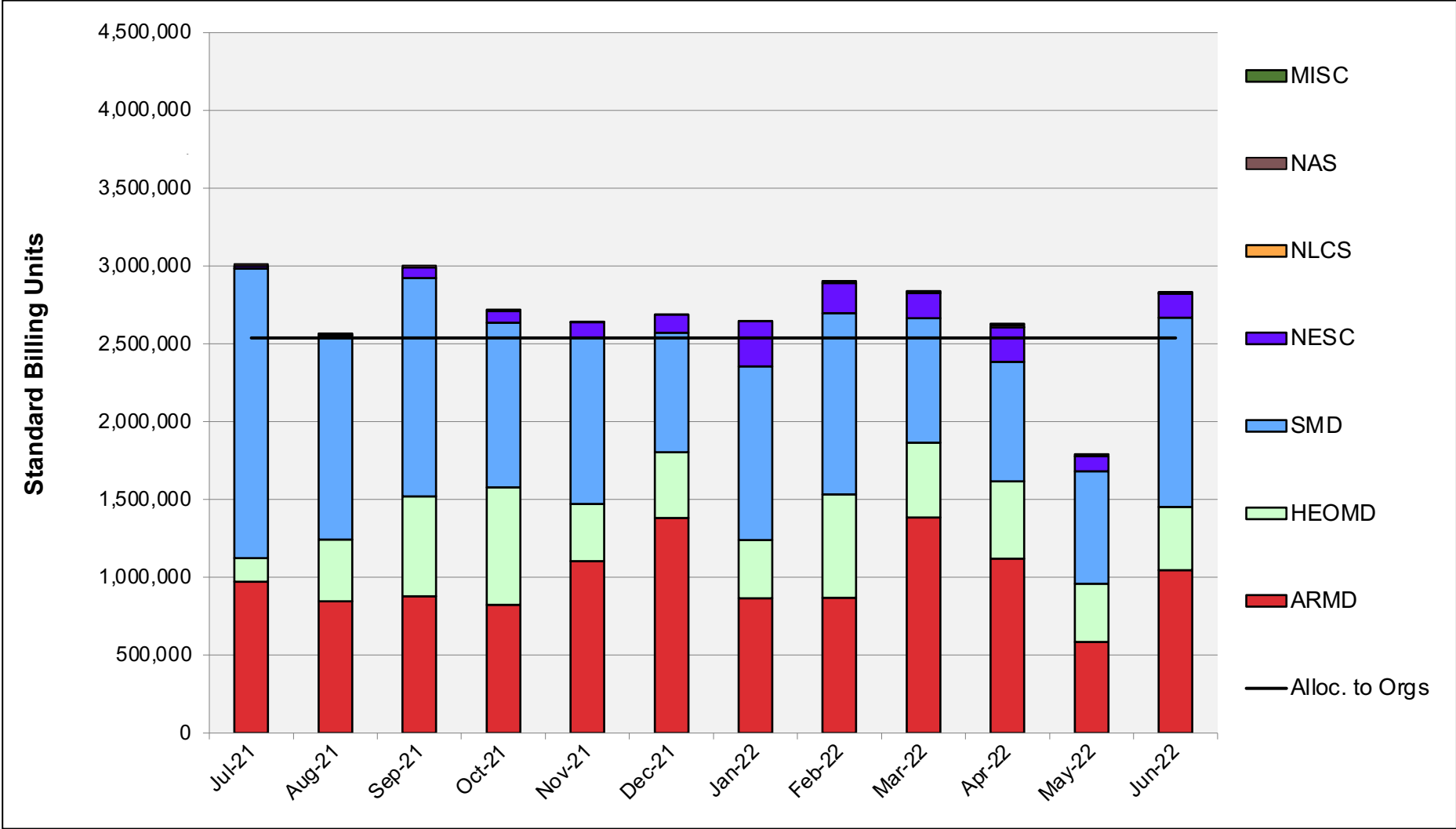
Electra: Devel Queue Utilization

Electra: Monthly Utilization by Job Length

June 2022
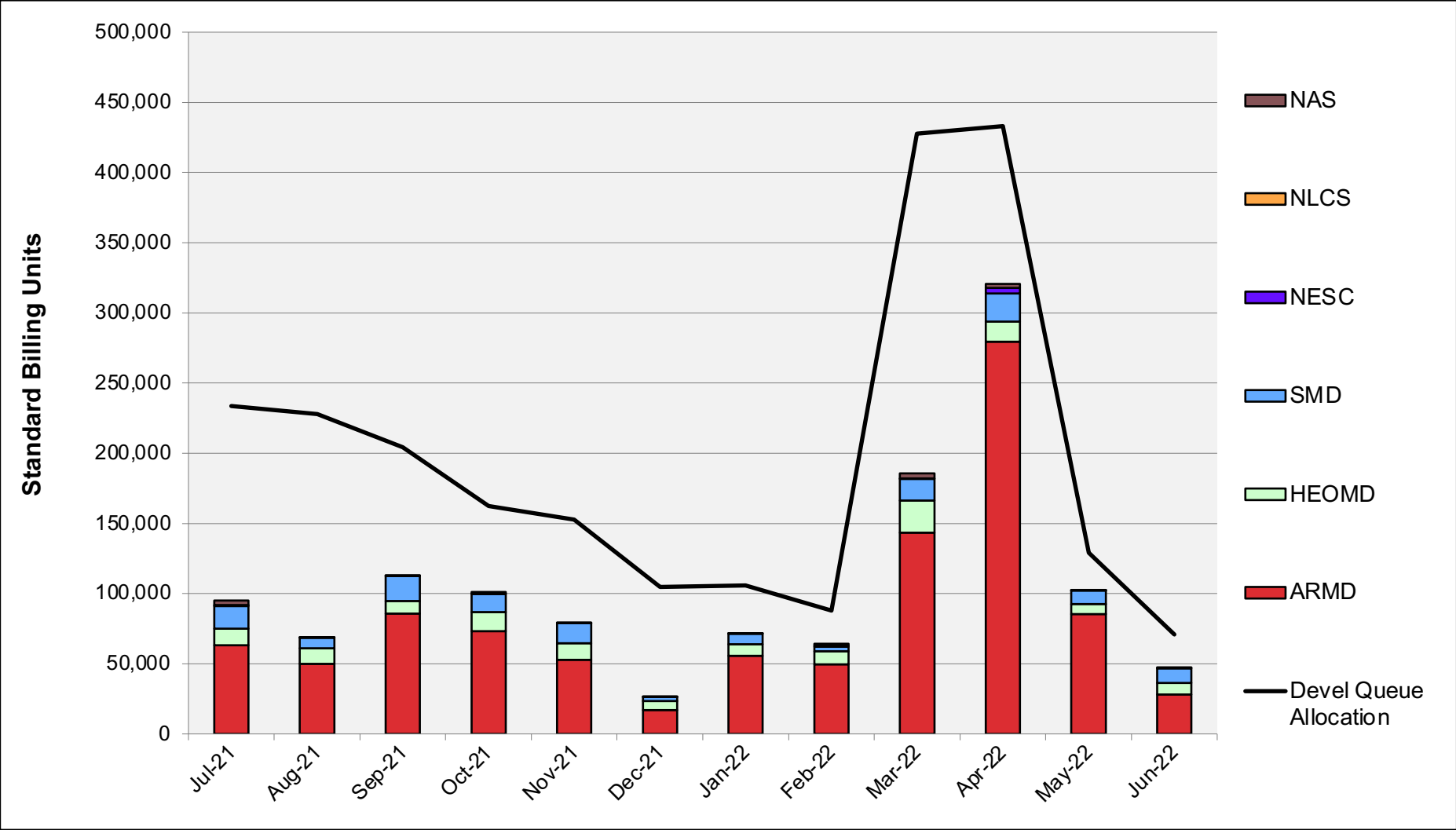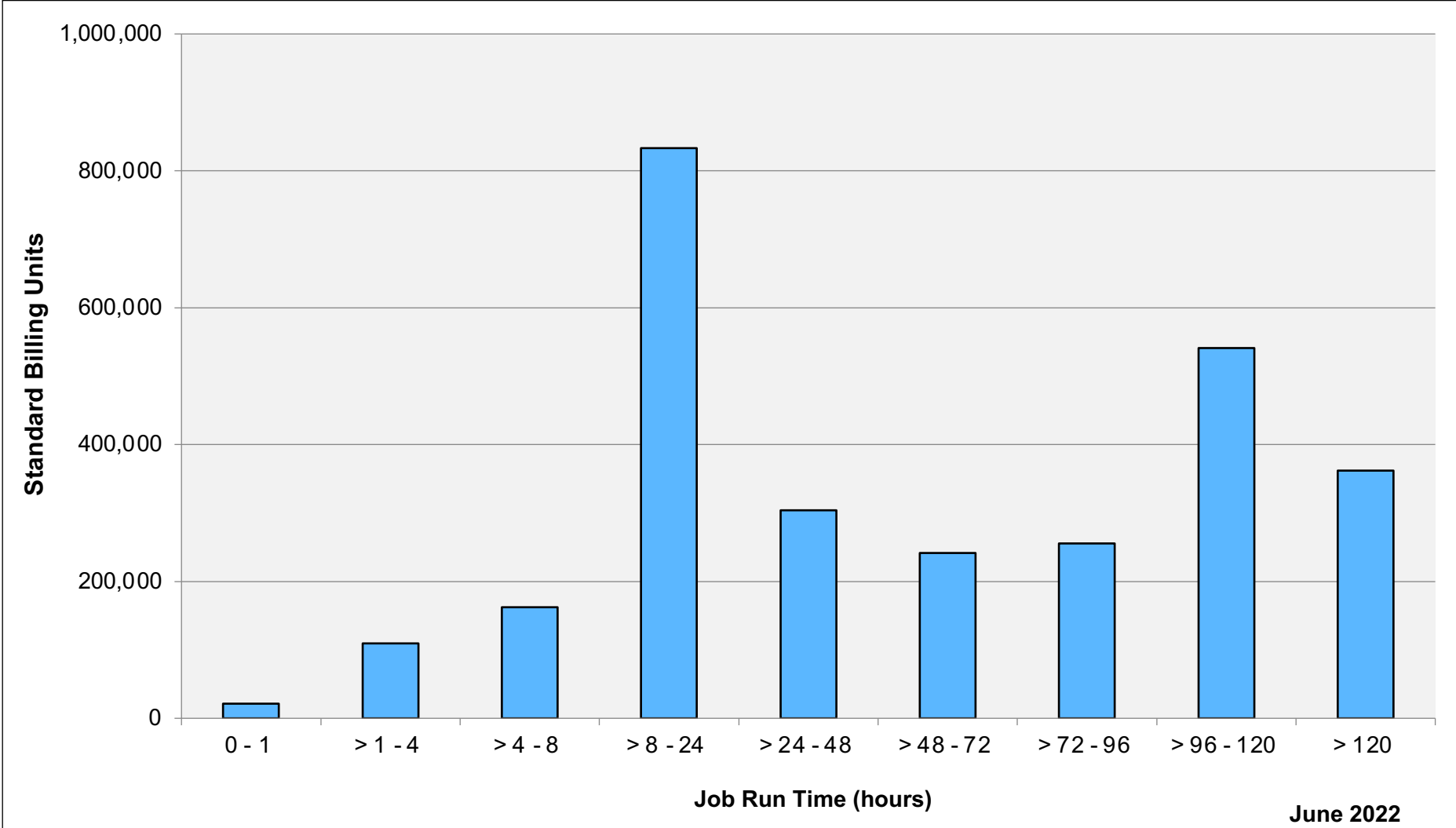
Electra: Monthly Utilization by Job Size
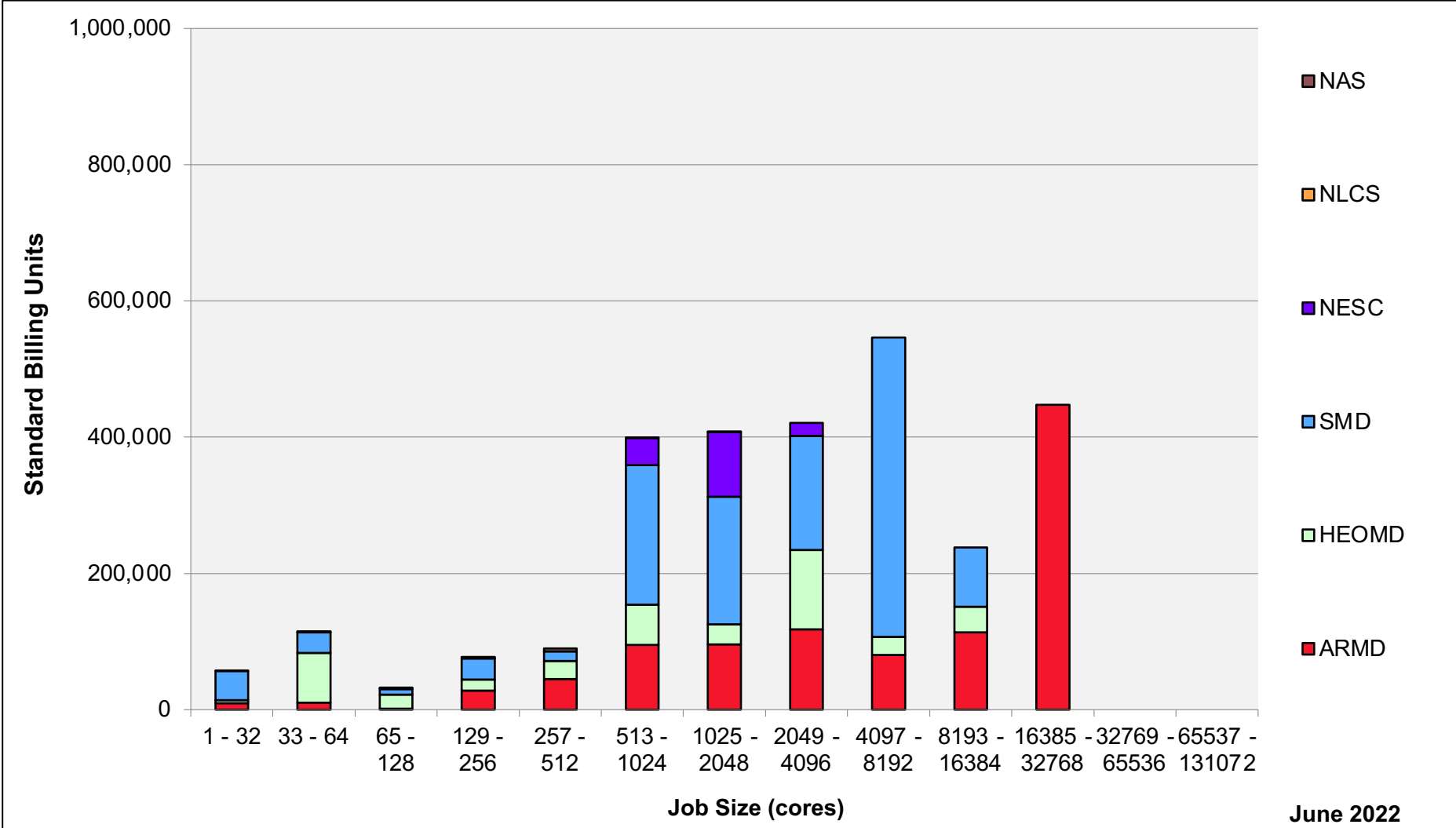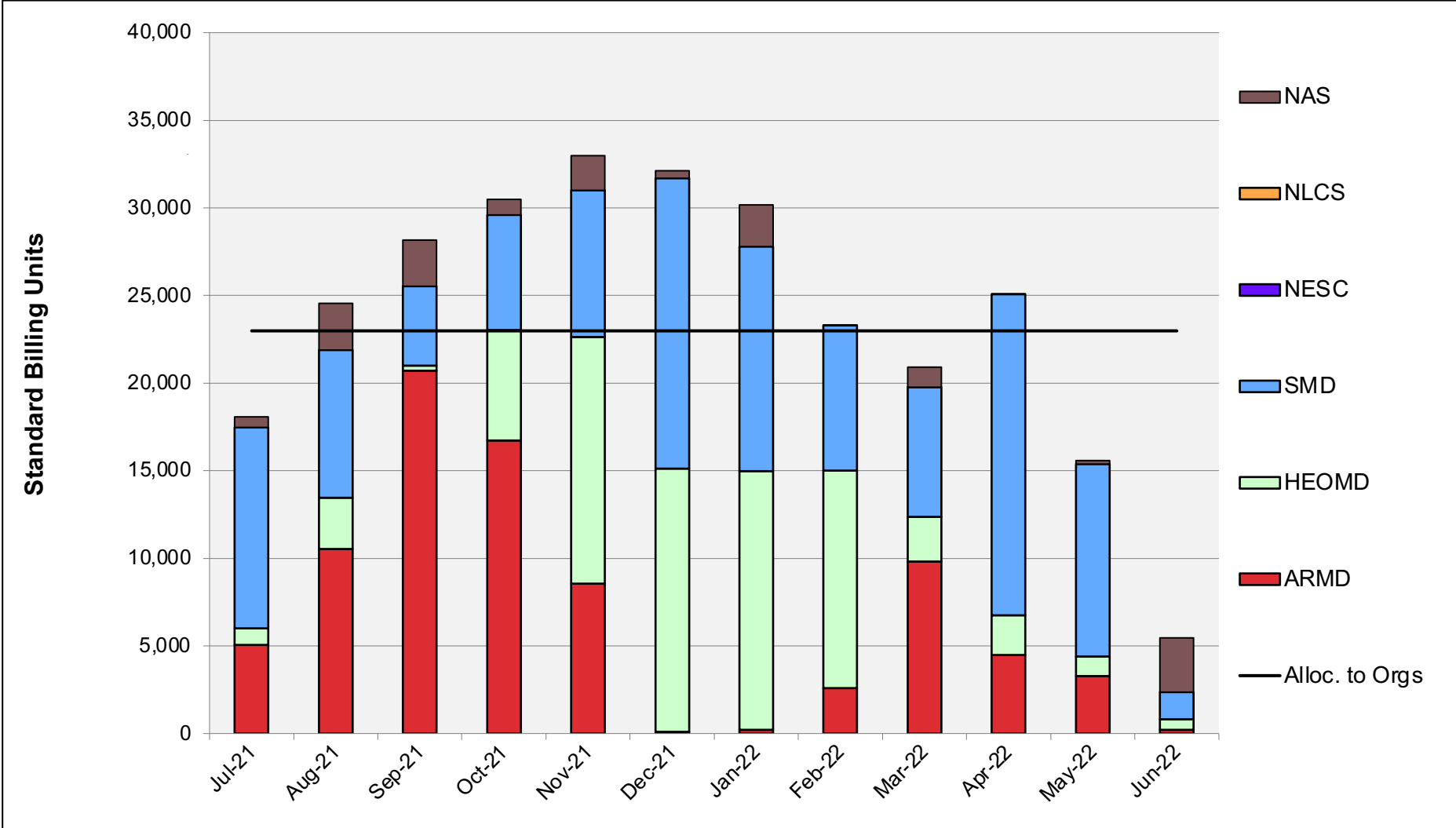
Electra: Monthly Utilization by Size and Length
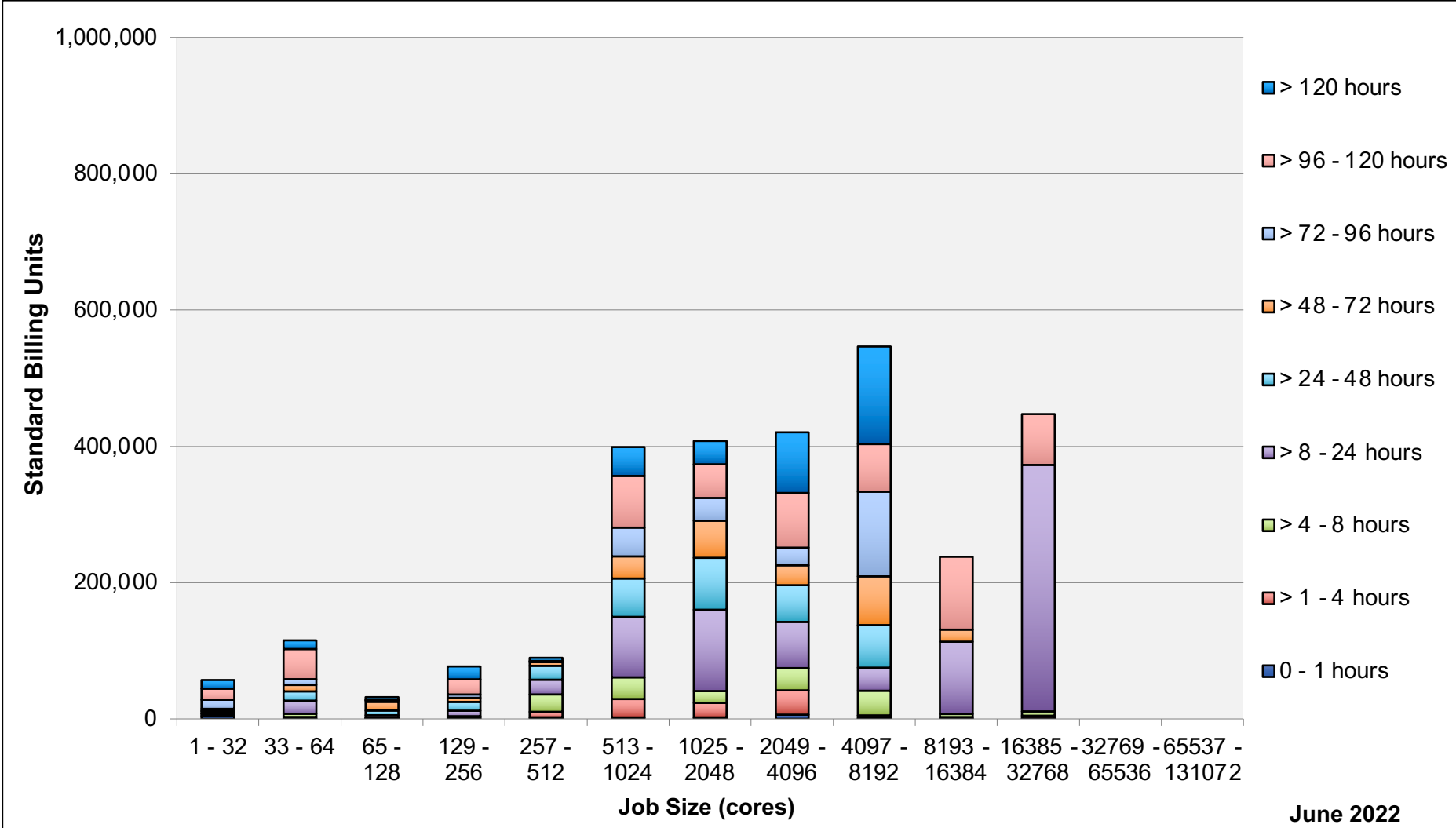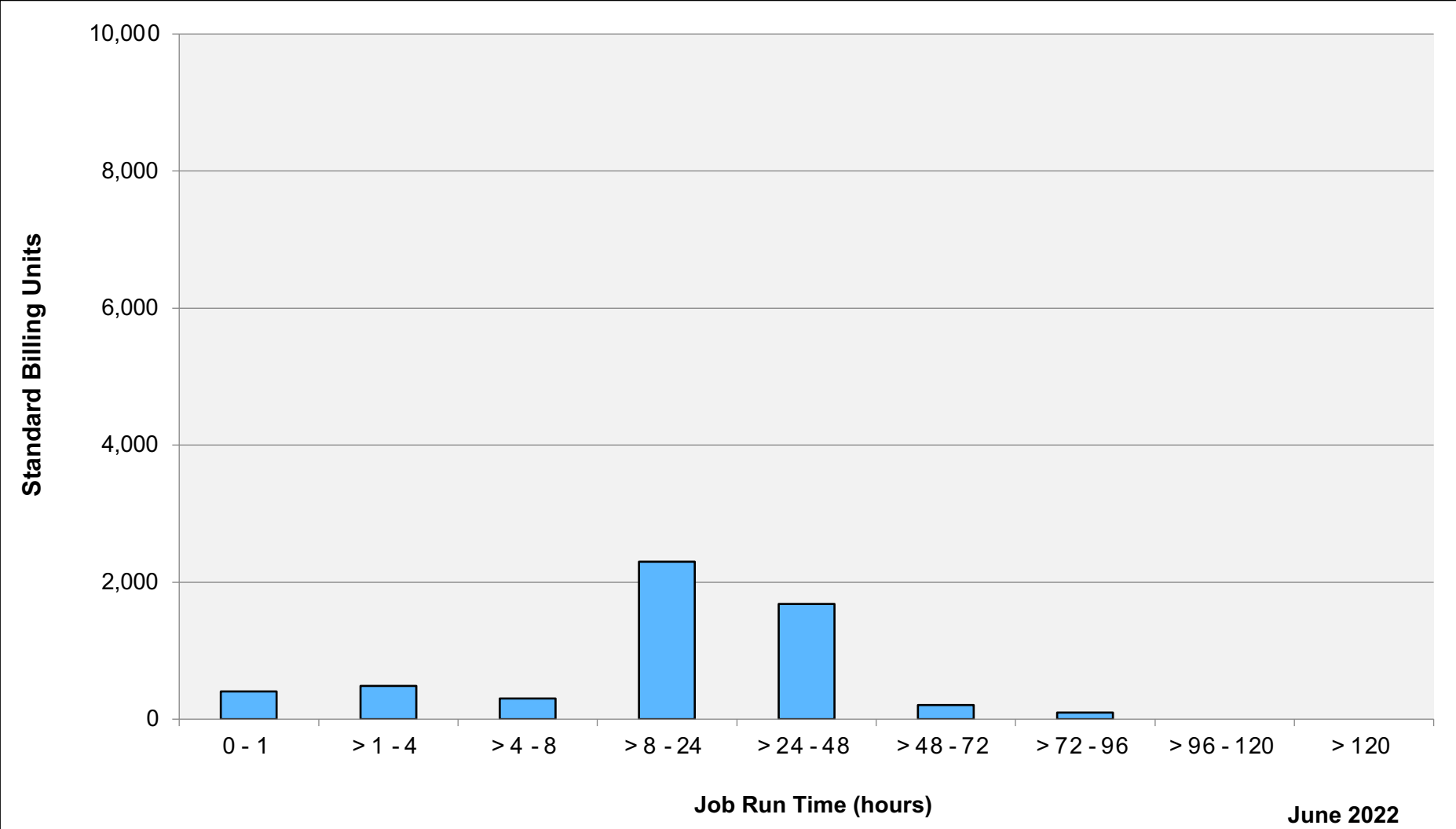
Electra: Average Time to Clear All Jobs
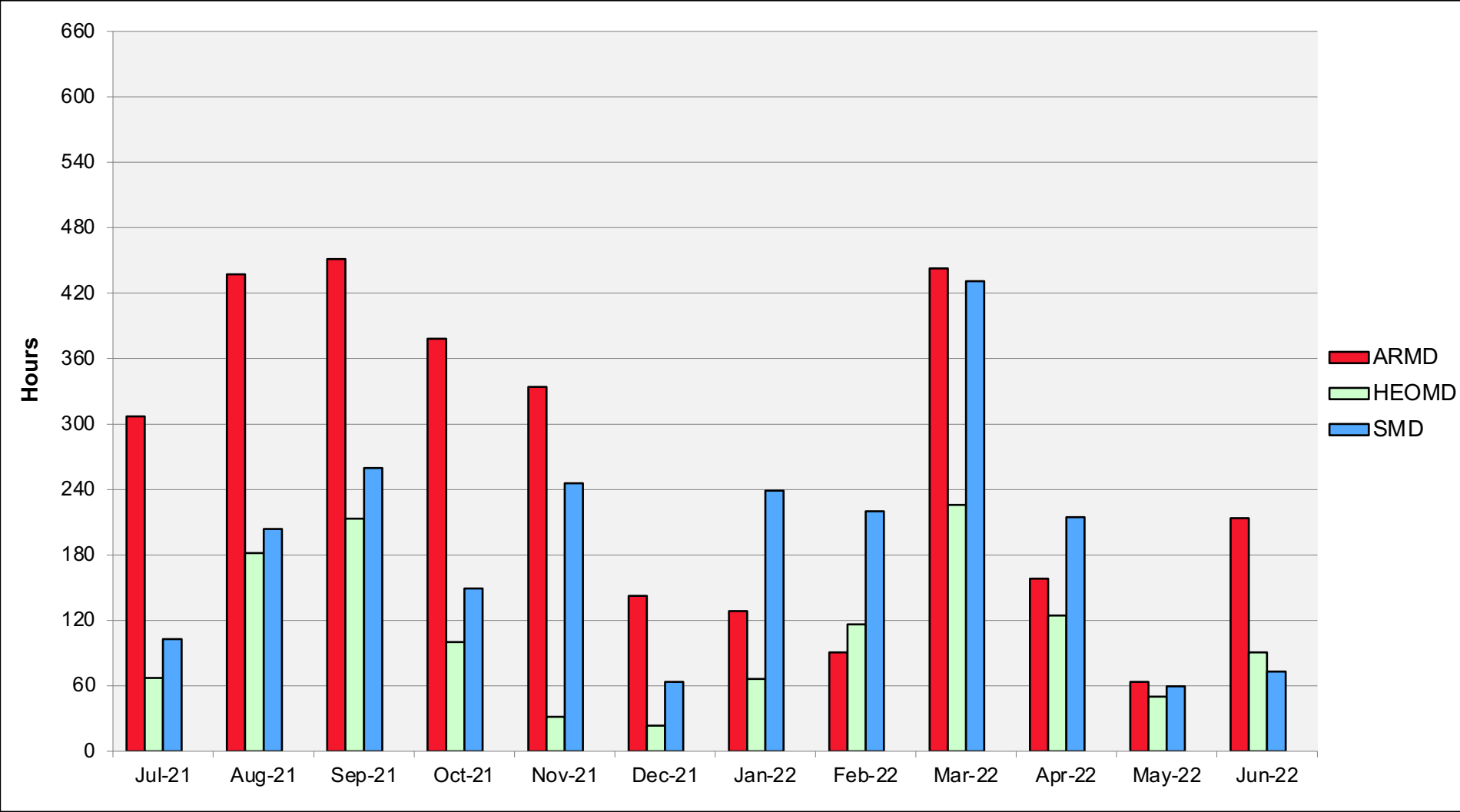
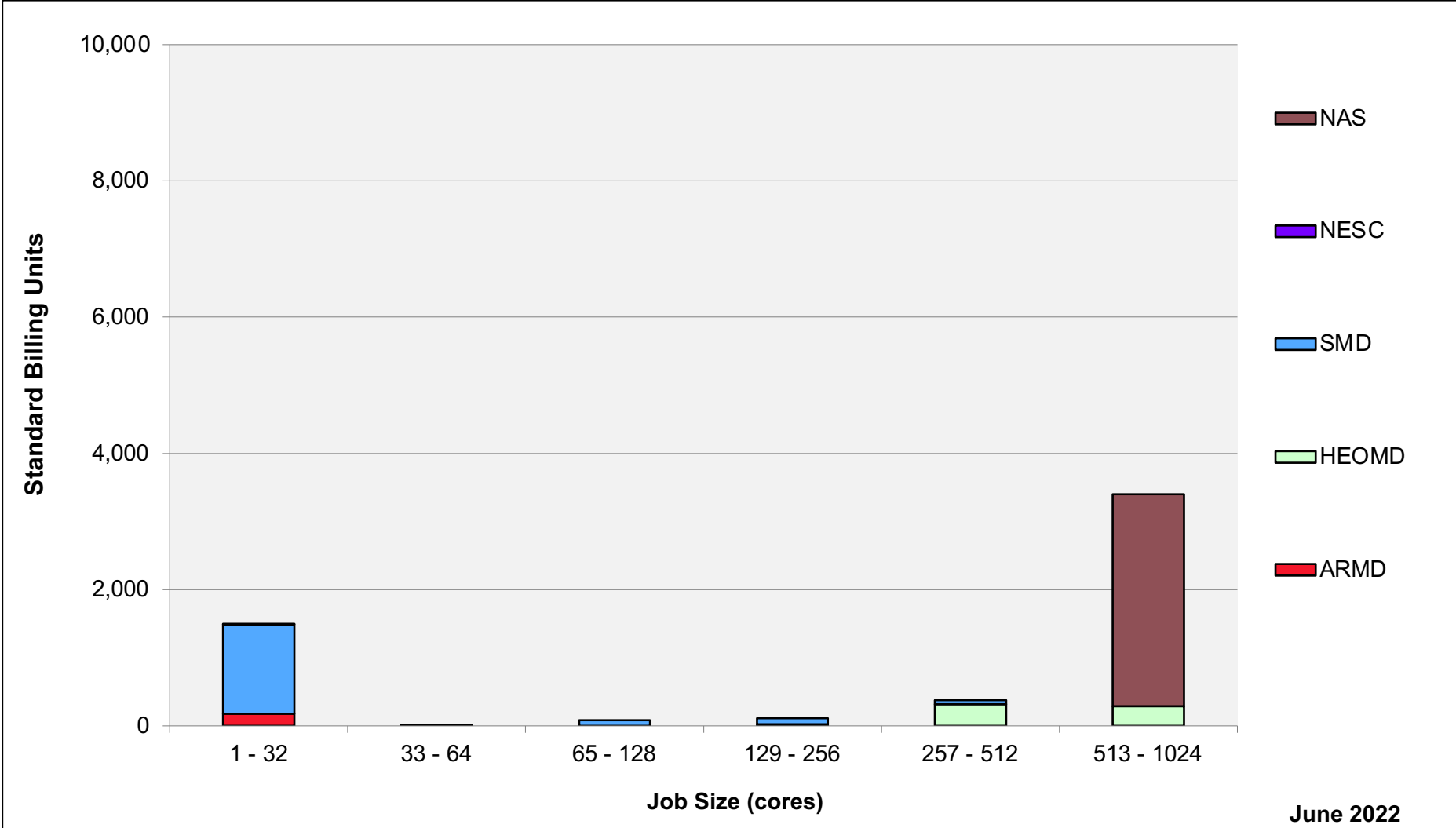# Electra: Average Expansion Factor
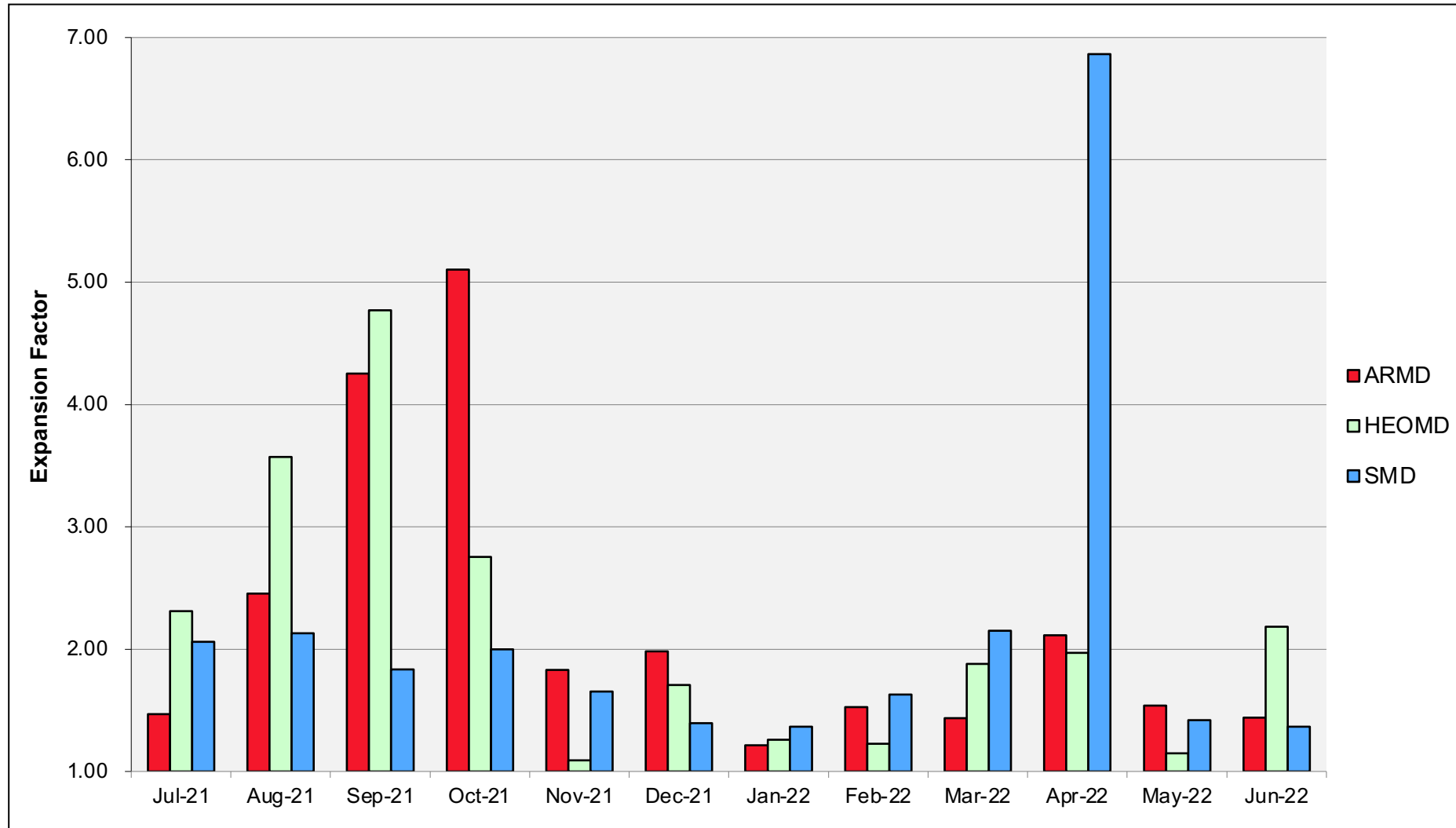
Endeavour: SBUs Reported, Normalized to 30-Day Month

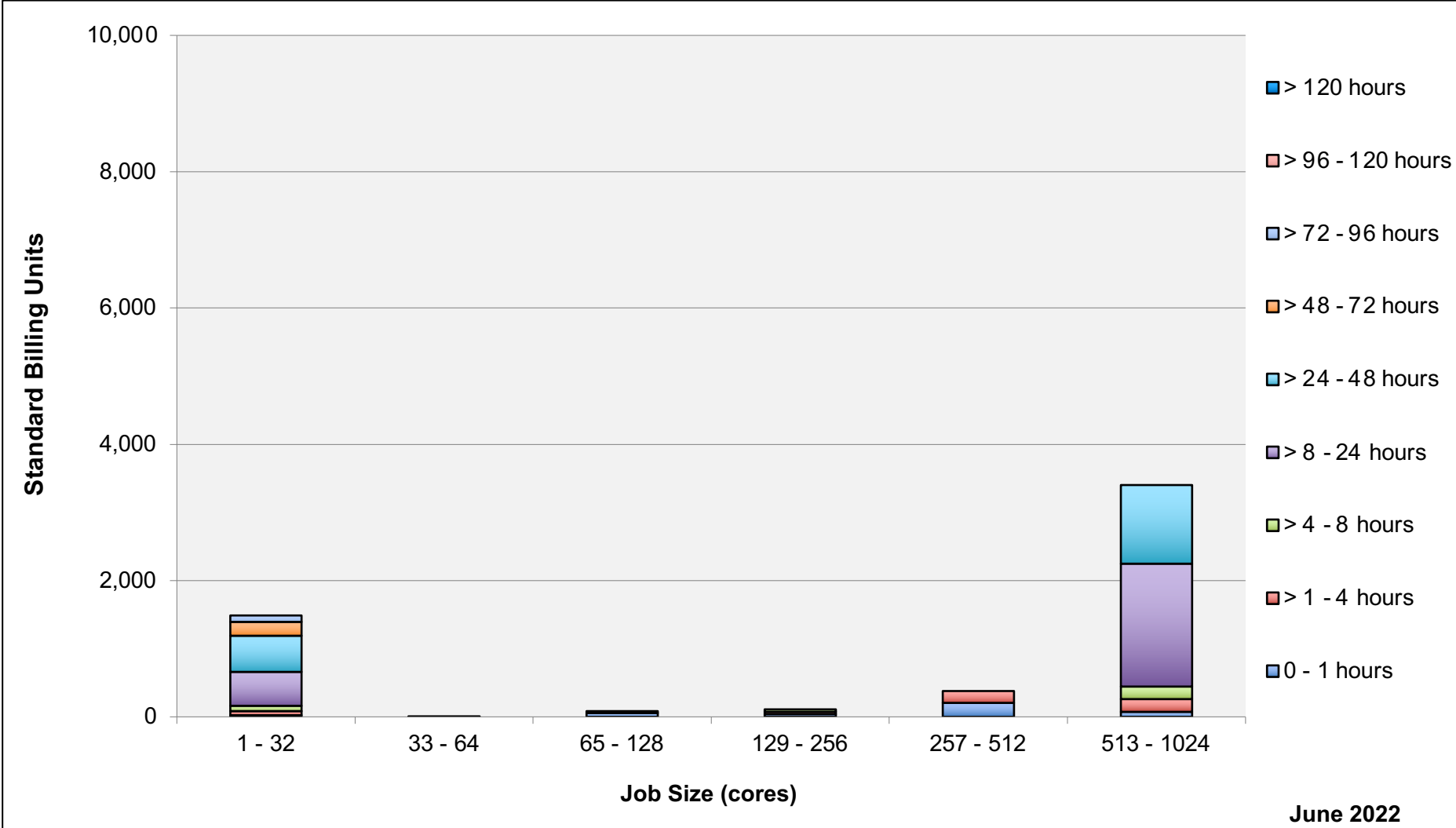# Endeavour: Monthly Utilization by Job Length

June 2022

Endeavour: Monthly Utilization by Job Size

June 2022

Endeavour: Monthly Utilization by Size and Length

June 2022

Endeavour: Average Expansion Factor